APRIL 1961 VOLUME 10 . NUMBER 4

Battelle Technical Review

IN THIS ISSUE: The Strength of Ceramic Materials

VIGNETTE

WILLIAM H. BROWNE

"Each of us, as the handiwork of the Creator, must be creative—give of our mind, emotions, and physical being—if we are to fulfill our potentialities," William H. Browne believes. "And this includes concern for our fellow men. One of the effective means for satisfying this need and acting upon this concern is pursuance of the natural sciences and of research as an activity in them. Physically, through research we help to establish a better life for our fellow men. Spiritually, the receptiveness and purposefulness implicit in research strengthen our faith—in the dependability of our fellow men, in the improvability of society, and in a future that will give meaningfulness to our lives."

In his early years at Battelle, Bill participated in a number of fuels and combustion studies. His research on the fracturing of coal helped provide a basis for determining the efficiency of coal pulverizers. He contributed to the improvement of home-heating equipment and to the development of an efficient air compressor and nozzle for flame throwers. In other research he has cooperated in the creation of semiautomatic equipment for producing saws and in the development of auto air-cooling equipment and automotive air cleaners utilizing filters of vegetable fibers.

With enlargement of his responsibilities—Bill is manager of the Institute's Mechanical Engineering Department—other areas of research came under his guidance. Investigation of magnetostrictive well-drilling methods, research on developments for the NRRS radiotelescope, and creation of a free-piston-engine-powered air-conditioning system have been among studies under his surveillance.

Bill's areas of concern embrace research on structures and strength of materials; thermal mechanics, including energy conversion, heat transfer, and other problems; and fluid mechanics, including fluid-flow, meteorological and aero-space investigations. His group also conducts research on manufacturing processes and equipment and on machine and product development.

A graduate of Rensselaer Polytechnic Institute, Bill served for a number of years as a research engineer with the Caterpillar Tractor Company. There he participated in studies on solid-fuel injection and radial air-cooled diesel engines.

Currently, he is a member of Sigma Xi and of the Executive Committee of the American Society of Mechanical Engineers' Machine Design Division. Bill's writings have grown out of his research and his interest in problems of human relations.

Family and community activities occupy much of Bill's free time. He and Carolyn, his wife, have only Jim and Peggy at home now that Bill, Jr. is at college. Nevertheless, they all get together for camping and hiking during vacations. Carolyn and Bill are both active in church work, while Bill devotes much effort to Boy Scout activities.

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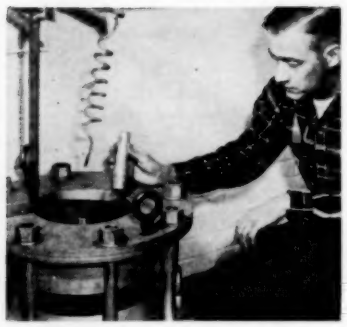


Removing a spark-formed metal component from the die.

HIGH-ENERGY ELECTRIC SPARK

Electrical energy is generally utilized mechanically as delivered by an electric motor or in the form of heat. Recent research has revealed that such energy can be used directly in explosive form. The explosive energy of an electric spark is apparent in the photo to the left, where it is being used at Battelle to form metal parts.

The current and voltage which create the spark are supplied by a capacitor bank capable of storing about 10,000 joules of energy. Once stored, the electrical energy can be recalled in a few microseconds to the desired point through heavy copper conductors (bus bars). The power of the resulting spark, which can be discharged in air, water, or any ionizable fluid, has not yet been determined.

Edward G. Bodine, who is conducting research for Battelle's metalworking group, points out that much is still to be learned about the phenomenon. Thus, problems associated with measurement of the current and voltage created when the capacitors are discharged are still to be solved. Variations in the nature of the resulting spark are yet to be explained, and better methods for controlling it are needed. And at this point, no positive switch is available for discharging the capacitors at a precisely determined time.

This great energy has many potential uses beyond metal forming. Also in the field of metallurgy it may find use in metal-powder compaction, in studies of phase changes in materials sensitive to shock and to rapid quenching, and in research on high strain-rate properties. The chemist may find it useful in speeding or slowing chemical reactions, studying plasma effects, and in pulverizing materials. For the electrical engineer the energy may contribute to research on the effects of high-voltage discharge on electrical equipment and to studies of extremely high magnetic fields.

the Strength of Ceramic Materials

Research is revealing factors important to the strength behavior of ceramic materials and could lead to broader use of these materials in important high-temperature applications.

by WINSTON H. DUCKWORTH *and* ALFRED RUDNICK

THE PROPERTIES OF AVAILABLE heat-resistant materials limit technological advances in propulsion, flight, and nuclear power. Ceramics demand special attention because of this situation. As a class, ceramics are noted for heat resistance and chemical stability. These along with a range of other obtainable qualities make ceramics valuable in many uses, but brittleness limits their usefulness for load bearing. Since loads often must be sustained by the sought heat-resistant materials, ways to improve the utility of ceramics as structural members are needed. Some possibilities of achieving this goal can be recognized.

Brittle behavior, in an engineering sense, means that the material breaks (fractures) without first exhibiting appreciable plastic flow. The ability to deform by plastic flow, before fracture, characterizes ductile materials. It provides a built-in mechanism in these materials that reduces stresses from such sources as notches, impacts, or thermal shocks. Our existing structural design technology has been developed for materials that are ductile.

Much research has been done on ductile ceramics, but without notable success. Cermets (bodies made from combinations of metals and ceramic materials) have received most attention in the search for ductile "ceramics". In general, ceramists have found that other interesting qualities of ceramics are lost when they contain sufficient metal to be ductile. More recently, another approach has been taken—that of imparting the plastic flow sometimes observed in MgO single crystals to a polycrystalline MgO ceramic. We do not yet know if this approach is feasible.

IMPROVED STRENGTH

Whether or not it can change the mode of failure from brittle to ductile, a higher fracture stress (i.e., strength) in ceramics is a desired goal. In considering load-bearing applications, it is axiomatic that no material is ever as strong as one would like it to be.

Fracture Theory

The strengths of ceramics theoretically could be much higher than they are—in the million rather than the thousand-psi range. An explanation of this as well as other fracture phenomena is provided by A. A. Griffith's widely accepted flaw theory of fracture. His theory proposes that flaws within the bulk or on the surfaces tend to concentrate applied stresses and that, as stressing proceeds, a critical condition is reached in a small volume that causes a submicroscopic crack to propagate spontaneously. Thus, the theoretical (molecular-bond) strength of the material is reached only locally, and the observed nominal strength is only indirectly related to the actual maximum stress at fracture. Griffith and others have put forward expressions for the observed strength, σ, as follows:

where, $$\sigma \sim \sqrt{\frac{E\gamma}{c}} \sim \sigma_{AAA} \sqrt{\frac{a}{c}}$$

E = Young's modulus
γ = energy to form a surface
c = crack length
a = atomic spacing
σ_{AAA} = theoretical strength

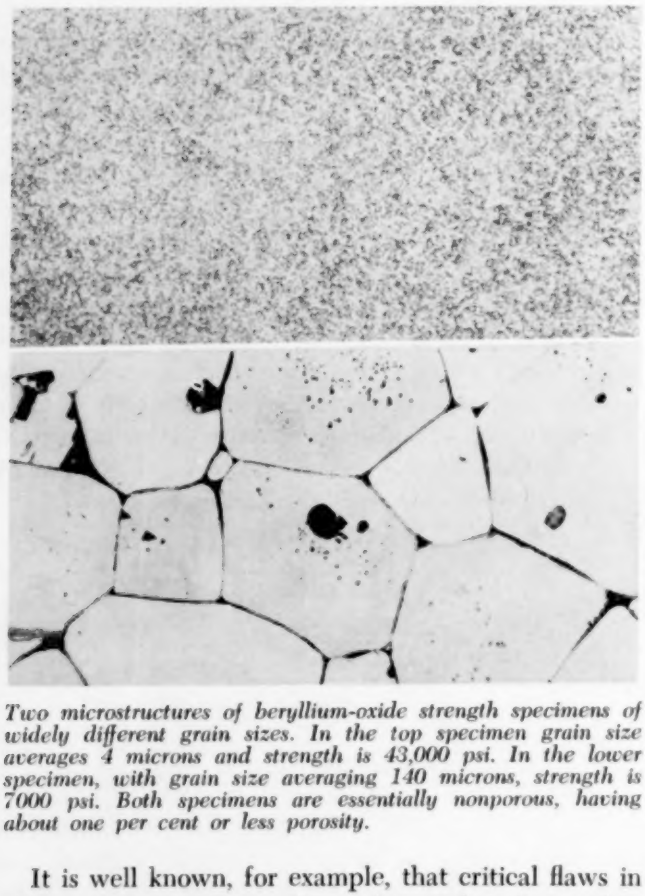
These relations define the applied stress required for crack instability in terms of physical constants and crack size for an assumed crack geometry and orientation. The matters of fundamental importance in improving strength obviously are crack initiation and growth, and knowledge in this area is quite imperfect. Even in the case of glass, whose strength has been studied most intensively, the source of cracks and processes by which they grow prior to spontaneous propagation are not satisfactorily understood.

The basic nature of crack initiation and growth undoubtedly will not be the same for all ceramics. Many types of inhomogeneities are found in ceramics that could act to concentrate stress and might lead to strength-limiting cracks—pores, grain boundaries, and

inclusions, to mention a few. It does not appear essential that the crack exist in the unstressed material. E. R. Parker has described a process by which stress-induced movements of imperfections in the crystal lattice can lead to crack formation. R. J. Charles has concluded that growth of critical cracks on glass surfaces can result from stress and atmospheric corrosion.

Practical Measures

Although specific knowledge of the processes leading to a fracture crack is lacking, there is information on strength behavior that can be used to guide the development of stronger ceramics.



Two microstructures of beryllium-oxide strength specimens of widely different grain sizes. In the top specimen grain size averages 4 microns and strength is 43,000 psi. In the lower specimen, with grain size averaging 140 microns, strength is 7000 psi. Both specimens are essentially nonporous, having about one per cent or less porosity.

It is well known, for example, that critical flaws in glass occur normally on the surface rather than within the bulk of the material. If this were not the case, tempering would weaken glass rather than strengthen it. Atmospheric effects on strength give evidence that surface flaws are critical in ceramic materials other than glass, including sintered alumina, porcelains, and single crystals of sapphire and periclase.

Accordingly, in approaching the problem of strength of a ceramic, it would seem important to learn whether surface flaws are critical and, if they are, to proceed as in glass technology toward modifying or protecting the surface.

Strength is markedly dependent on internal structure, too. We know that pores and other scattered inclusions can drastically weaken a ceramic body, as is shown in the figure on page 6. Also, the strength of a polycrystalline body has been observed to be related to grain size. Strength has been shown to decrease with grain growth, as illustrated on page 7. The microstructures of two of these specimens are shown left below.

The strength behavior of some ceramics has been interpreted as being affected by residual stresses frozen in individual grains. That many ceramic materials do not lose strength at elevated temperatures might be explained, for example, by the relief of these frozen-in stresses when the materials are heated. Differences in thermal-expansion and elastic properties between adjacent grains cause these stresses to develop, so they are associated with grain boundaries. Their level is dependent on grain size, and instances are reported where such stresses are high enough to cause separation between grains in coarse-grained bodies. Because of possible differences in relative crystallographic orientation between grains in monophase bodies, grain-boundary stresses can be present in such bodies; they are not limited to polyphase bodies.

Depending on the particular ceramic, then, strength might be increased by preventing flaw development or growth on the surface by tempering or by adjusting grain-boundary stresses. Certainly reducing porosity and other scattered inclusions are steps in the right direction. Reduction in grain size also is likely to be beneficial. And there probably are other, yet unrecognized, features of the microstructure that influence strength. Microstructural effects on strength are being studied at Battelle, but significant data are not yet available.

Sintered Bodies

Monophase polycrystalline bodies, products of solid-state sintering reactions, are of major interest from the standpoint of heat and corrosion resistance. To develop strong bodies, one desires at least to promote pore removal and to restrict grain growth during sintering, two sintering phenomena that are related. A pore must be adjacent to a grain boundary to be removed with reasonable ease during sintering. Also, pores that are adjacent to grain boundaries restrain grain growth. Because of these relations and the fact that pores are always present between particles of compacted powders, the internal geometry at the start of sintering is a favorable one. This favorable geometry does not usually persist, however. As sintering proceeds, the porosity is reduced to a level at which it can no longer

restrain grain growth. Grain boundaries move over pores, and the internal geometry transposes to one that is unfavorable for pore removal, but favorable for grain growth.

Obviously, if this transposition must take place, we want porosity reduced as much as possible before it occurs and, after it occurs, we want grain growth to be as sluggish as possible.

Many ceramic-processing variables affect the changes in internal geometry that occur during sintering. And, from the standpoint of developing stronger refractory ceramics, we think that these variables can be adjusted better than they have been yet. Variables of importance include: the purity and other features of the powder raw material; the degree that the powder is compacted; the time-temperature relations during sintering; and the atmosphere in the sintering furnace.

Control of the ceramic-processing variables is perhaps equally important. Nonuniform particle size in the powder raw material, poor pressure distribution in compacting, temperature differences in the compact during sintering, and other such inhomogeneities may cause pore removal to be arrested by grain growth.

Research to idealize the processing has not been extensive. Most ceramic practice is based on liquid-phase sintering rather than solid-state sintering. Liquid-phase sintering requires a composition in which some liquid develops at a temperature below the melting point of the major phase. Obviously, for highest heat resistance, we can not resort to this practice. Further, included material in the microstructure is expected to lower the strength ultimately attainable.

In the study of solid-state sintering, much attention has been given to pore removal, and measures are well known that can reduce porosity—increased sintering temperature, use of finer powder, sintering under pressure (hot pressing), specific additives, and others. Ceramic scientists, too, have learned much about the kinetics of initial pore removal. On the other hand, little research has been done on later stages of sintering, when the internal geometry tends toward one favoring grain growth and arresting pore removal. For higher-strength bodies, we need to know how to restrain this tendency, and research has not yet pointed the way to do it satisfactorily.

Thus, rapid progress toward stronger refractory ceramics is hampered by limited knowledge of factors that control changes in internal geometry during the late stages of sintering. Research in this area could be most profitable.

Sinterable forms of powder, such as developed at Battelle in research on pure refractory-oxide ceramics, appear to lend themselves admirably to developing fine-grained dense bodies. These oxide powders are products of pyrolyzing selected compounds, and the temperature for pyrolyzing each is critical. With the sinterable powders, extensive pore removal takes place at extraordinarily low sintering temperatures, and grain growth can be varied over wide ranges with the porosity at a quite low level. The graphs on page 7 illustrate the type of information we have obtained through the use of these powders. The higher strength values (graph, page 7) are about twice as great as any previously reported for pure BeO ceramics.

Design Considerations

Though less obvious than the need for improved materials strength, improved design technology is equally important. To be useful, the ceramic need only sustain a desired load. The structural designer, however, must know what load can be sustained.

Conventional structural design is based on allowable stresses obtained by applying a suitable safety factor

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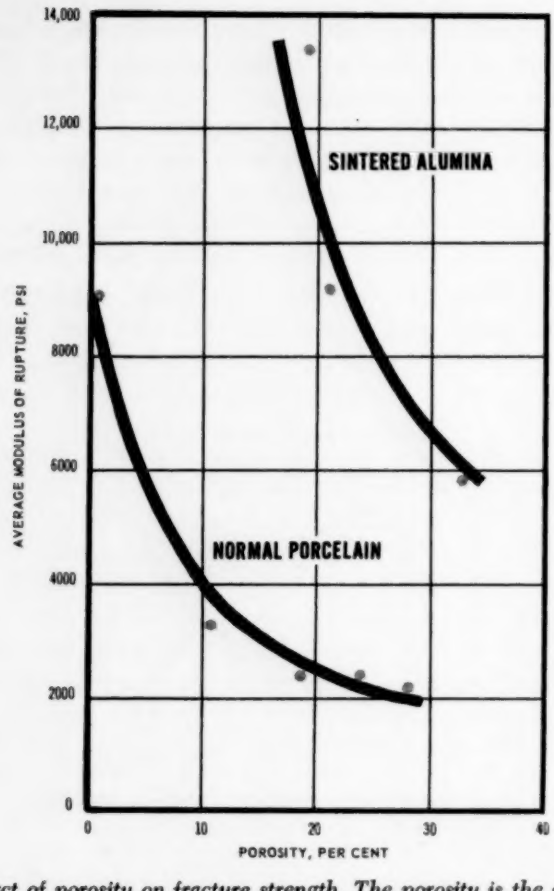
Winston Duckworth has long been interested in factors that determine properties of ceramic materials. Over the years at Battelle he has been engaged in research on most types of ceramic materials. Investigations of the phenomenon of brittle fracture and of strength behavior have been a special interest of his. He has conducted and is currently responsible for the guidance of research on: glasses and porcelain enamels; refractories, portland cement, and graphite; and ceramic whitewares, structural clay, nuclear ceramics, and other ceramic materials. A fellow of the American Ceramic Society and secretary of the National Institute of Ceramic Engineers, he is also a member of the Refractories and the Whiteware Committees of the American Society for Testing Materials. Since 1948, he has continuously served on panels and committees of the Materials Advisory Board of the National Academy of Science—National Research Council.

Alfred Rudnick's primary field of research interest is structural mechanics, with special concern for the mechanical properties of materials important in space technology. His analytical and experimental activities at Battelle have included investigations of the effect of specimen geometry on measured ductility of metals, stress concentrations in elastic materials, and the mechanical properties of oxide materials at elevated temperatures. He recently conducted a study to develop design relationships required for use of coated graphite as the leading edge of a re-entry vehicle. His current interests include the mechanical properties of visco-elastic materials. Prior to his association with Battelle, Rudnick participated in research with the Public Health Service and Case Institute of Technology.



Effect of porosity on fracture strength. The porosity is the ratio of pore volume to the total volume of the specimen.

to the yield or ultimate strength of a material that exhibits plastic flow. Strength values are usually obtained from uniaxial laboratory tests on standardized specimens. Methods are available for applying this information to biaxial and triaxial stress states. When unanticipated stress concentrations occur in such materials, plastic flow provides a margin of safety.

Because the safety mechanism of plastic flow is absent, design with brittle materials is more demanding. The stress analyst must be careful to account for all possible stress concentrations. Also, the determination of a design stress and how to use it in the case of brittle materials presents a problem totally different from that encountered with ductile materials.

Strength Characteristics

Two characteristics of a brittle material make conventional methods for determining design stresses inadequate: (1) its strength values are statistically distributed over a relatively wide range, and (2) the range over which the values are distributed, and their mean, depend on the size of the specimen and the stress state to which it is subjected. These effects are shown in the figure on page 8.

Because of the scatter in strength values, a large number of specimens must be tested to determine the strength distribution. Even so, the resultant information is not sufficient. The mean value obviously cannot be used, nor, in general, is there any assurance that the lowest value observed in the test is the actual minimum strength of the material. Also, because the fracture strength distribution is a function of size and stress state, the question arises as to whether prototype testing will be required. We would much prefer to be able to predict the behavior of the material under complex conditions from data obtained in simple laboratory tests.

A rational method for selecting a design stress can be found if the distribution of fracture strengths and the size and stress state dependence can be related mathematically. Such relationships, which could permit determining the fracture strength distribution for any component from convenient laboratory tests, have been proposed.

Starting with the flaw theory of fracture discussed earlier, we can account for the scatter in strength values and its size and stress-state dependence. At least conceptually, each specimen contains numerous flaws distributed statistically as to severity. Several theories then purport to describe how the strength values are affected by the flaw-severity distribution. Basically, the theories fall into two general classes. According to one, fracture of the single most severe flaw results in total fracture of the specimen. This follows the "weakest-link" concept. The other class of theories allows that total fracture need not result from a single flaw. Fracture of a single flaw results in a redistribution of stresses. Total fracture then occurs when the remaining material in the specimen can no longer carry the redistributed load. The weakest-link concept is the most widely accepted. Mathematically it is simpler, and it gives reasonably good correlation with experimental data.

The size effect, according to the weakest-link concept, arises from the greater probability of severe flaws in large than in small specimens, simply because the larger specimen contains more flaws. For the same reason, a group of large specimens should exhibit less scatter of fracture strengths than a group of small specimens. Following this reasoning, a group of large specimens will have a lower mean strength and a lower standard deviation than will a group of geometrically similar small specimens. (See figure on page 8.) Experiments support these conclusions.

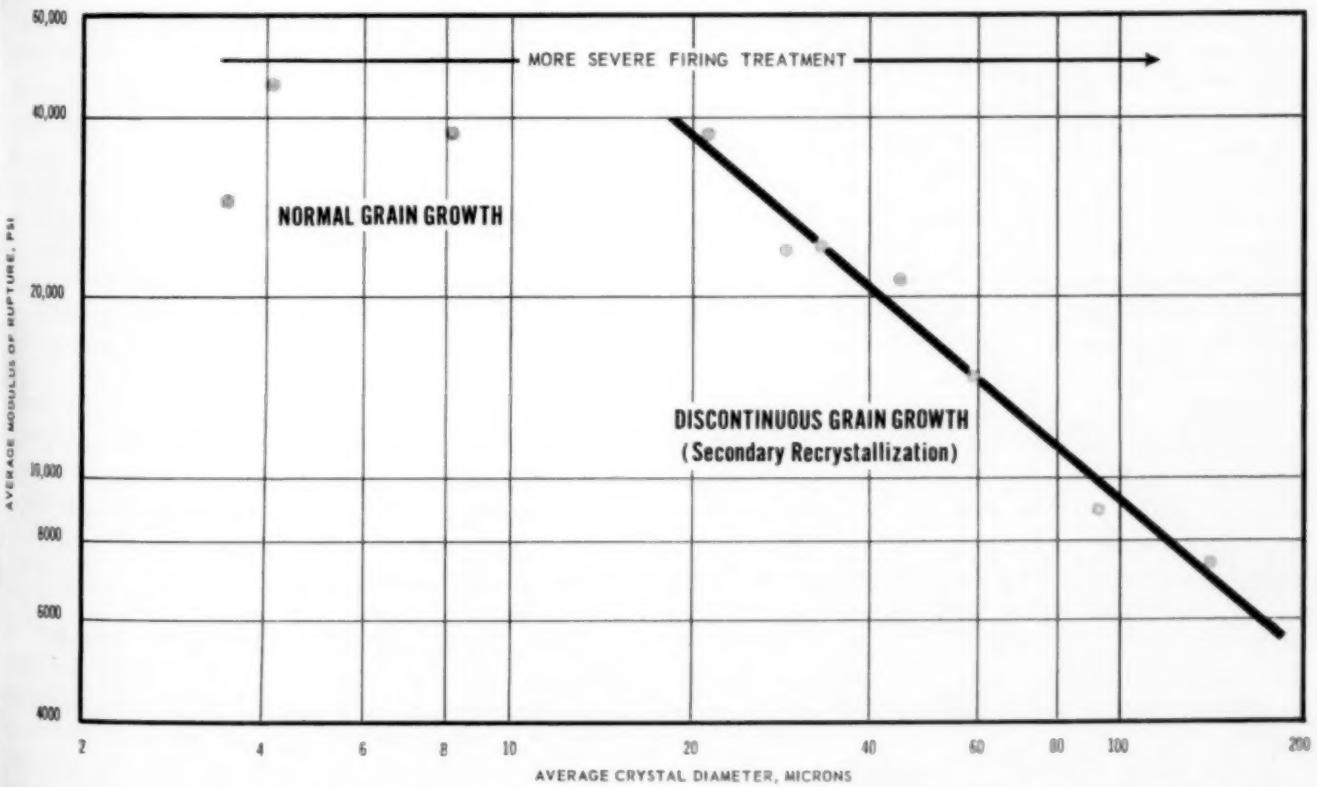
The stress-state effect can be considered as a corrollary to the size effect. The reason can be visualized by considering a beam subjected to pure bending. A

portion of the beam is in compression. Because the compressive strength of most brittle materials so far exceeds the tensile strength, it is reasonable to assume that fracture will not begin on the compression side of the beam. For purposes of analysis, then, the size of the beam can be reduced to that portion in tension. As the nominal tensile stress increases linearly from zero at the neutral axis to a maximum at the outer surface, a severe flaw near the neutral axis would be less likely to cause fracture than a much less serious one near the surface. This effect also can be represented as a decrease in the effective size of the beam. In line with the effect of size discussed above, specimens subjected to pure tensile stress will have a lower mean strength and have strengths distributed over a smaller range than will geometrically identical specimens subjected to bending. These effects also are illustrated in the figure on page 8.

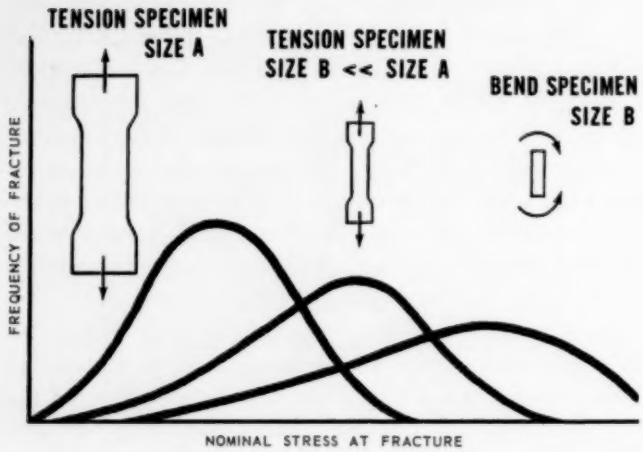
Analytical Treatments

B. Epstein has shown that the general weakest-link problem can be treated quantitatively by statistical methods. The problem is to predict the distribution of strengths among a group of geometrically identical specimens cut from a parent body of material which contains numerous flaws. Because the strength of each specimen will be fixed by the most severe flaw it contains, the distribution of most-severe flaws among the specimens must be found. This distribution can be calculated if the distribution of the flaw severities in the parent body is known. Conversely, if the distribution of most-severe flaws (or strengths) for the specimens is known, the distribution of flaw severities in the parent body can be deduced. The mathematical theories further provide methods for finding analytical relationships between strength distribution and specimen size. Although this approach is very general, it has the disadvantage of requiring a large amount of experimental data. There are other statements of the problem which can, in some cases, reduce the amount of experimental data required.

Before the more general aspects of the weakest-link theory were recognized, several investigators proposed mathematical solutions based on assumed fracture-strength distributions. The most widely accepted is that proposed by W. Weibull. Weibull postulated distribution of fracture strength in terms of two parameters. He then determined the dependence of these parameters on size and stress state. Once these two parameters have been determined for a given material, it is theoretically possible to find the distribution of strengths of this material for any stress state. He



Relationship between strength and crystal size of dense beryllium-oxide ceramics. Normal grain growth is slow and uniform. Discontinuous grain growth is rapid and nonuniform.



Effects of specimen size and of stress upon fracture strength distribution of a brittle-state material. Size A (larger) specimen has a lower mean fracture strength and has its strengths distributed over a narrower range, than the size B (smaller) specimen. As shown by the bend specimen, a specimen subjected to a nonuniform stress state (bending, torsion, etc.) is equivalent, from the statistical standpoint, to a smaller tension specimen.

derived relationships between fracture-strength distributions in tension, bending, and torsion. Reasonable experimental verification of these relationships has been obtained.

Selection of a Design Stress

Since fracture takes place over a range of nominal stress values, it would seem reasonable in design to specify an acceptable probability of fracture. The design stress corresponding to this probability would then be found from the strength distribution.

A more conservative method for selecting a design stress is available, however. It involves use of the "zero strength"—that stress level below which no fracture will occur. In general, a natural zero strength exists, but we know of no acceptable way to determine it. However, an artificial zero strength can be imposed by using only material that has passed a proof test in which a stress—the desired minimum strength—is imposed.

If the artificial zero strength is to provide a rational design approach, there must be a sound basis for its selection. There is evidence that the zero strength, like the mean strength, is a function of stress state and size. If this is the case, choosing a zero strength on the basis of, say, laboratory tensile tests, may lead either to overdesign or to an inordinate number of rejects in the final proof test. It is to avoid just such overdesign or excessive rejects that a reasonable design stress is sought.

As has been stated, it is theoretically possible to predict the distribution of strengths for any stress state and size from the strength distribution for any other stress state and size. Knowing the distribution for laboratory test conditions, one might therefore compute the strength distribution for an actual component and, by examination of this distribution, select a reasonable zero strength to be imposed in the proo test. It also will provide an estimate of the number of rejects which can be expected.

In general, the strength distribution will be a function of temperature, atmosphere, and strain rate. It is obvious that the design stress must be chosen for the most critical combination of these to be encountered by the structure.

Research Needed on Design-Stress Selection

The statistical treatments are not yet at a point where they can be used effectively for design purposes. Research is needed in the following areas:

Fracture-Strength Distributions. Existing data on the strength of ceramics are inadequate to investigate statistical theories. It is possible, for example, that the Weibull theory may be applicable to some, but not all, ceramics. For materials whose behavior is not satisfactorily described by the Weibull or other existing distribution functions, the more general approach suggested by Epstein can be used to advantage.

Improvement of Testing Methods. The evaluation of statistical theories requires experimental data obtained under a high degree of control. Slight variations in certain testing conditions sometimes appreciably affect the measured strength of brittle materials. Research is needed to improve existing testing procedures and to develop new ones especially suited for brittle materials.

It is extremely important that any comprehensive investigation of fracture-strength relations be conducted on well-controlled material. Process variables can introduce strength variations not accounted for in the statistical theories. The statistical theories assume that the material is invariant.

Treatment of Additional Stress States. One of the present limitations of statistical treatments is that solutions are available only for relatively simple stress states. Analytical work should be extended to cover other stress situations.

Study of Zero Strength. As has been indicated, the zero strength may be a function of the size and stress state to which a body is subjected. This possibility should be explored further. It would be a significant advantage if a material could be given a relatively simple proof test, say by bending, and the data used to predict the zero strength in other situations.

Recent Developments in Lubricants

Chemists are synthesizing lubricants and developing additives for petroleum oils and greases to meet the lubrication demands of today's technological environments.

by Stanley L. Cosgrove *and* Richard L. Jentgen

If you accept the "facts" that "nothing rolls like a ball", and that "nothing lubricates like oil", then *presto,* with an oil-lubricated ball bearing you have probably solved a high percentage of lubrication problems! Unfortunately this Utopian situation does not prevail. Although refined petroleum oils, and greases obtained by gelling petroleum oils with metallic soaps, adequately take care of a very high percentage of today's lubricant needs, several well-defined trends have spurred the development of nonpetroleum or synthetic lubricants during the past decade. These trends fall into three main categories:

1. Since we now live in the age of jet aircraft and space vehicles, advanced engineering concepts demand lubricants capable of withstanding extreme environments. Such environments may include or combine extremes of temperature, very low ambient pressures, high-energy radiation, sonic or ultrasonic vibration, and reactive chemical environments.
2. The design engineer continually seeks the ultimate in miniaturization and reliability. For lubricated components, this usually means higher loads carried by smaller amounts of lubricant. He assumes reliability by sealing his lubricated component in inaccessible locations where the lubricant is expected to perform adequately for the life of the component or system.
3. Last, but most important to those who deal with less glamorous hardware, is the realization that in many mundane applications, synthetic lubricants can outperform their petroleum derived counterparts. Although synthetic lubricants are invariably higher priced, in many applications lubricant cost is a minor fraction of the total investment.

Two types of prepacked automotive bearings. A bearing with a threaded steel plug which may be removed for regreasing is shown above. Below is a cutaway view of a prepacked bearing showing the steel ball and plastic bushing.

The following sections highlight some of the more significant material developments in synthetic fluids, solid lubricants, and greases. This is a part of the chemist's contribution, which can only show practical value when integrated with the efforts of the metallurgist, the physicist, and the design engineer. Each has his part to play in lubrication technology.

Synthetic Fluids

Synthetic fluids (lubricants and hydraulic fluids) may be defined as liquids, usually pure chemical species, prepared by a series of one or more chemical

reactions which link relatively small molecules together to form larger molecules. By contrast, corresponding petroleum fluids are usually mixtures of several hundred chemical compounds, built by nature and refined to acceptable purity by man. Both types of fluids perform essentially the same functions: the separation of loaded surfaces under relative motion to one another or transmission of mechanical forces from one location to another.

Synthetic fluid development first reached commercial production status during World War II when the German lubricants industry was faced with a critical shortage of suitable petroleum stocks. The main part of this effort was directed to the synthesis of hydrocarbons of structures similar to those found in petroleum-derived lubricants. The Fischer-Tropsch process was used to prepare mixtures of saturated and unsaturated hydrocarbons. Low-molecular-weight hydrocarbons were then polymerized to hydrocarbons of suitable molecular size, and the Fischer-Tropsch waxes were cracked to produce similar fluids. In addition, the Germans successfully developed processes for copolymerizing ethylene with petroleum fractions. These *ersatz* materials, although chemically similar to natural petroleum lubricants, were, in general, inferior in almost all respects.

During the past fifteen years synthetic-lubricant and -hydraulic fluid needs have changed. Engineering demands have presented new challenges to the lubricants chemist. There has been increasing need to produce fluids with properties superior even to those available from today's sophisticated petroleum refining techniques. The seemingly endless complexity of requirements falls logically into two classifications:

1. Fluids capable of withstanding extreme environments.
2. Fluids that permit less wear, less surface damage, or enable the handling of greater loads under more adverse conditions of relative motion.

To satisfy these needs, two approaches have been adopted—the synthesis of new fluids and the development of special additives to enhance fluid properties or to impart new properties to fluids.

Today, the lubricants chemist no longer restricts his efforts to copying petroleum structures. The need dictates the structure: organic structures fashioned with high-strength chemical bonds, or those which take advantage of resonance energy, provide thermal stability; the elimination of potentially reactive hydrogen atoms improves oxidation stability; highly aromatic structures are resistant to radiolytic degradation. Unfortunately, the achievement of one desirable property often results in the loss of other equally de-

Comparing Petroleum With Synthetic Oils

	VISCOSITY-TEMPERATURE CHARACTERISTICS[a]	VOLATILITY	FLAMMABILITY	OXIDATION STABILITY	THERMAL STABILITY	HYDROLYTIC STABILITY	LUBRICATING CHARACTERISTICS	COSTS[b]
POLYALKYLENE GLYCOLS	+ +	0	0	—	0	0	0	5 to 20
ORGANIC ESTERS	+ +	+	0	0	+	0	+	10 to 30
SILICONES	+ + + +	+ +	0	+ +	+	0	— —	100 to 200
PERFLUOROCARBONS	— — — —	— —	+ + +	+ + + +	+	+ +	— — —	500 to 1600
HALOGENATED HYDROCARBONS	—	—	+ +	—	—	—	—	10 to 20
PHOSPHATE ESTERS	—	+	+	0	—	—	+	5 to 40
SILICATE ESTERS	+ + +	+ +	0	—	— —	— — —	—	30 to 40
POLYPHENYL ETHERS	0	+ + +	0	+ +	+ +	0	0	500 →

(a) Properties are compared with petroleum oil of similar viscosity ratings: + (better than petroleum oil); 0 (about equivalent to petroleum oil); — (worse than petroleum oil).

(b) Number of times greater in cost than petroleum oil at arbitrarily selected base price of 30 cents per gallon.

Adapted with permission from *Chemical and Engineering News*, vol. 34, page 4247, Sept. 3, 1956. Copyright 1956, American Chemical Society.

sirable characteristics. Thus, many radiation-resistant fluids show high pour points, and the elimination of hydrogen atoms may be accompanied by poor viscosity-temperature properties. The task of the lubricants chemist is not easy. On the other hand, in the petroleum oils, nature has effected an excellent compromise with unrivalled over-all qualities. This is very evident in the comparisons made in the table on page 10.

The search for new and improved additives for lubricants and hydraulic fluids continues unabated. As a direct result of much elegant research in the thirties and forties, petroleum lubricants for automotive use may now contain antioxidants, detergents, bearing-corrosion inhibitors, oiliness additives, extreme pressure additives, pour-point depressants, viscosity-index improvers, and antifoam agents. It is a tribute to the lubricants chemist that, in some instances, with so little petroleum oil present, such mixtures can perform their primary function. In most synthetic fluids, however, because of their specialized application and good inherent properties, such extensive compounding is unnecessary. This is indeed fortunate, since many additives designed for petroleum oil are neither compatible with, nor expecially effective in, synthetic fluids.

Until quite recently, major efforts in additive development for synthetic fluids centered on antioxidant development. Of the "classical" antioxidants, only aromatic amines (such as phenyl naphthylamines) have found extensive usage in synthetic oils, and in many cases they have been superseded by more complex and costly additives (e.g. nitrogen- or selenium- and silicon-containing heterocyclic compounds; polycyclic aromatics). Some applications, for example turboprop aircraft, have called for synthetic lubricants with good load-carrying ability. Organic phosphorus compounds such as tritolyl phosphate have proved useful additives for such applications. Increasingly higher temperature requirements have revealed a deficiency common to almost all synthetic fluids—inadequate viscosity at high temperatures. Conventional viscosity-index improvers are of very limited utility in correcting this inadequacy. Moreover, fulfillment of this need, as with all others in synthetic fluids, is greatly hindered by a lack of knowledge of additive mechanisms. From limited work to date, two things are evident—mechanisms of additive function can be quite different under extreme environments, and, in addition, known mechanisms of additive action in petroleum fluids cannot necessarily be extrapolated to predict effectiveness in synthetic fluids.

Dr. Cosgrove's primary interest is the study of lubricants—their formulation, structure, and use. Much of his research has been concerned with synthetic lubricants and additives to improve their properties. With Battelle colleagues he has studied the fundamentals of the relationships between lubricant structures and performance, and he has been concerned with the effects of radiation on lubricants, fuels, and hydraulic fluids. He has contributed to the development of special-purpose greases, high-temperature solid lubricants, and lubricants for sintered bearings. In other studies additives for residual fuels and effective low-friction coatings for metals have been sought. Before his association with Battelle, Cosgrove conducted research on fuels and lubricants for Shell Oil. He is secretary of the American Society of Lubrication Engineers' Committee on Bearings and Bearing Lubrication.

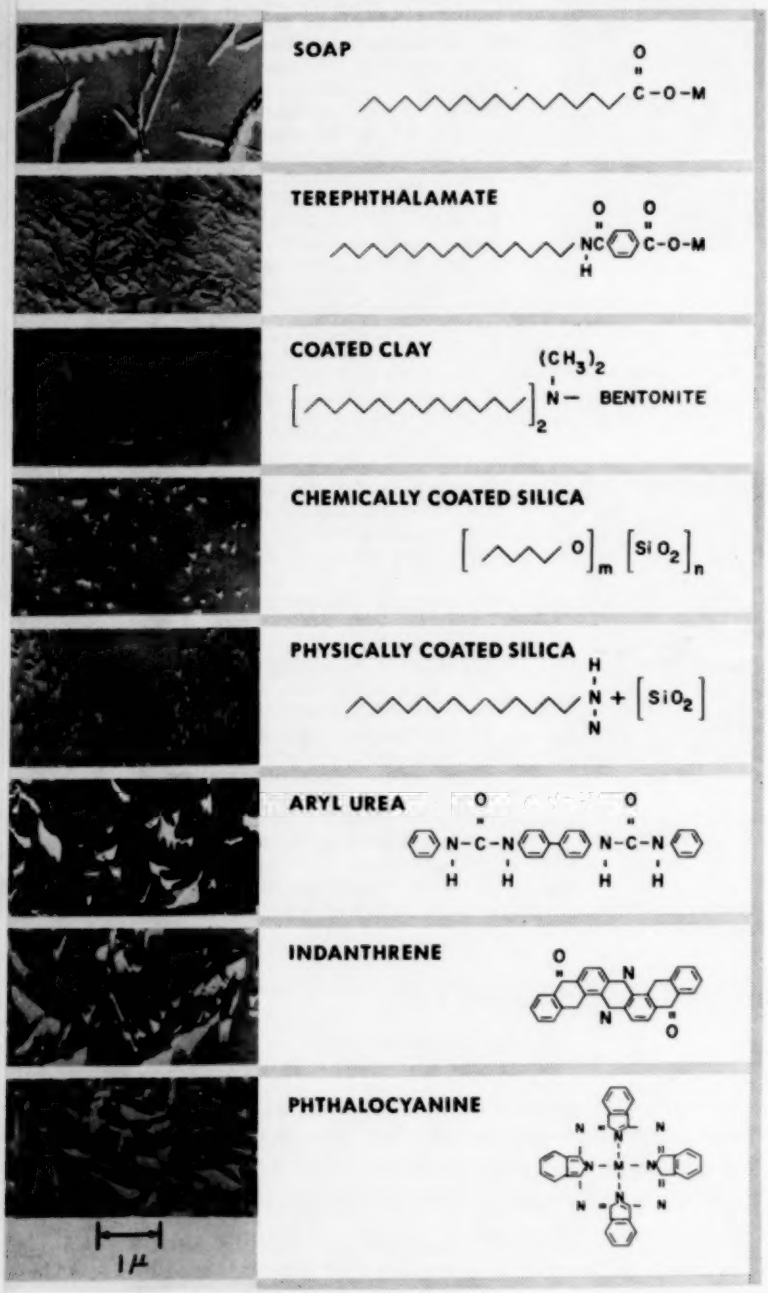
Research in the coal tar, petroleum, and lubricants areas of organic chemistry has been Richard Jentgen's concern since he joined Battelle. With his colleagues he has conducted studies on high-temperature solid lubricants and has formulated special-purpose greases and evolved methods for evaluating them. He has also been associated with development of such products as swaging lubricants, rolling oils, and functional fluids. In other research Jentgen has contributed to methods for rapidly identifying creosote and petroleum mixtures and for characterizing petroleum and tar products. He has participated, too, in research leading to possible uses of lignite tar and to methods for evaluating the toxicity of wood preservatives. Jentgen is currently a member of the Fundamental Research Committee of the National Lubricating Grease Institute.

Solid Lubricants

One of the greatest strides toward achieving the maintenance-free automobile has resulted from new developments in solid lubricants that have enabled the auto manufacturers either to eliminate, or drastically reduce, the number of grease fittings in the 1961 cars. One motor company's products for 1961 use prepacked, nylon-bushed bearings on the steering linkage points. No service is recommended for these points at any time. The solid lubricant in this case is the nylon surface itself. This year's cars produced by another company have no chassis grease fittings whatsoever! Nine prepacked bearings are used on the steering linkage and the ball-joint suspension. The solid lubricant is molybdenum disulfide (in a grease base). These are but two of the countless ways in which solid lubricants are contributing to engineering and ultimately to our convenience and even our national security.

The term "solid lubricants" covers products of a

STRUCTURES OF SELECTED GELLING AGENTS.



Courtesy L. C. Brunstrum and the Research and Development Department, American Oil Company

wide variety of physical forms and chemical species. Physically, the solid lubricant can take the form of a bulk solid, a thin film, or dispersions in liquids or greases. Chemically, they can be organic or inorganic, reactive or inert. The following listing shows types and examples of solid lubricants:

- Bulk solids, organic (used as self-lubricating materials of construction)—Delrin, nylon, and polytetrafluoroethylene (Teflon) resins.
- Thin films, inorganic (usually resin-bonded)—Molybdenum disulfide, lead oxide, tungsten disulfide.
- Thin films, organic (wear pieces precoated or coatings formed *in situ*)—Teflon, phthalocyanines.
- Liquid dispersions, organic and inorganic (solids in a volatile solvent or lubricating fluid carrier)—Molybdenum disulfide, graphite, boron nitride, Teflon telomers.
- Grease dispersions, organic and inorganic (solids in a grease carrier)—Molybdenum disulfide, graphite, Teflon.

The properties of solid lubricants are as varied as is their physical form and chemical makeup. For instance, graphite and molybdenum disulfide are lamellar solids which suggests that their lubricity is inherent in their planar crystalline structure; the crystallite (layer lattice structure) shears parallel to the layer lines when these lubricants are functioning. While graphite is very inert, molybdenum disulfide has a definite chemical affinity toward metals. Both are stable to high temperatures; in air, graphite begins to oxidize at about 850 F, MoS_2 at about 575 F. In contrast to the lamellar solids, Teflon exhibits a very low coefficient of friction because it is more cohesive than it is adhesive. It, too, is inert and stable to relatively high temperatures (to 600 F).

A rather new solid lubricant, which shows remarkable thermal stability (to more than 850 F) for an organic compound, is metal-free phthalocyanine. The phthalocyanine molecule has a planar structure (the planes are separated about the same distance as those in graphite) and can be reacted with metal surfaces to form the metal phthalocyanine.

Solid lubricants in thin film applications perform best if the surface is hard and has some degree of roughness. Pretreatments are used (e.g., sand blasting for stainless steel, acid etching for aluminum, phosphatizing for iron) for insuring optimum adhesion to the wear surfaces. In addition, the individual lubricant should be suited to its environment (e.g., graphite performs poorly in a heated vacuum; molybdenum disulfide oxidizes in air at about 600 F to form molybdenum trioxide which is, by comparison, abrasive). If the speeds and loads are within reasonable limits, a long service life can be expected of such lubricant films.

Solid lubricants serve a range of applications from the ordinary to the exotic—from sidewalk vehicles to space vehicles. Graphite (in a fluid) is used in wire drawing and other metal-working applications. Solid

bearings are made from Teflon and nylon. As a rule, solid lubricants are used where other types of lubricants are likely to attract dust, lint, or other airborne debris and where the adjacent parts must not be contaminated with fluid lubricants. These coatings are used also where maintenance would be expensive and where equipment is located in environments which could promote deterioration or loss of fluid lubricants. Where bearings are inaccessible or are likely to be overlooked, solid lubricants should be considered.

Solid lubricants generally have the following advantages:

1. They are more resistant to removal by pressure than are fluid lubricants.
2. They are very resistant to deterioration in storage.
3. They are resistant to high temperatures.
4. Most of them exhibit good load-carrying capacity.

The following can be considered disadvantages:

1. Many solid lubricants are dark or highly colored, and in metal-working operations they may be unsightly or difficult to remove.
2. In thin films they are not replaceable or self-healing.
3. They do not dissipate frictional heat.
4. For most, the coefficients of friction are not so low as those for fluids under conditions of fluid-film lubrication.

In summary, use of solid lubricants has proved to be the only way to solve many frictional problems. They have become increasingly important in space technology. The urgency of research in this area of our national defense need not be further emphasized.

Greases

Greases are a lot like wet sponges. When squeezed, rubbed, or warmed they will give up (although reluctantly at times) a portion of their fluid composition. The gel structure of a grease, like the sponge, is a contrivance which finds its utility in holding a fluid until it is needed to perform its destined function.

Greases, at their simplest, are composed of a lubricating fluid and a gelling agent. In their specialized forms, greases can contain a great variety of additives to help them function effectively in more demanding situations. In this age of supersonic aircraft and nuclear power, there is a need for greases which can resist extreme temperatures and ionizing radiation. Such requirements have forced the development of grease components so different that little of the ancient art of grease technology is applicable.

Since greases are made up of 60 to more than 95 per cent lubricating fluids, the properties of the greases will be influenced to a great extent by the properties of the base fluids. This influence becomes especially significant for greases which must function in extreme environments. Although the presence of the gelling agent alters the properties of the base fluid to some degree, fluids for advanced greases must conform to the stringent requirements (e.g., thermal stability, evaporation loss, etc.) imposed on the finished grease. Such requirements usually dictate the choice of a synthetic fluid. Since all of the synthetic fluids mentioned earlier in this article have been used as base fluids for advanced greases, the reader is referred to the table (page 10) for examples of synthetic base fluids.

As a general rule, grease development closely follows fluid development. After promising fluids are developed, a search is made for a gelling agent which, when incorporated into the fluid (in a reasonable concentration), will gel the fluid to a grease consistency. In recent years, these gelling agents have embraced a wide variety of chemical species. (In former years, fatty acid soaps were used almost exclusively for gelling oils.) Some of the recent developments in grease-gelling agents are listed below:

GELLING AGENT	FOR USE IN
Terephthalamates	Radiation-resistant greases
Coated clays	"Multipurpose" and medium-temperature greases
Coated and uncoated silicas	Medium and high-temperature greases
Aryl ureas	High-temperature, radiation-resistant greases
Indanthrenes (anthraquinoneazine)	Extreme-temperature, radiation-resistant greases
Phthalocyanines	Extreme-temperature greases
Carbon blacks	Extreme-temperature greases

It would be an oversimplification to say that during grease lubrication only the fluid component is involved at, or enters the friction site. The gel structure itself can be very influential. Some of the nonsoap gelling agents are lubricants themselves (e.g., metal-free phthalocyanine, anthraquinoneazine). Even the time-honored fatty-acid soaps contain some amount of free fatty acids which can form soaps with the metals of the wear surfaces resulting in improved lubrication.

To gel organic fluids, certain gelling agents must be made organophilic (i.e., easily wetted by the fluid). Some inorganic gelling agents (e.g., clays) are rendered organophilic by chemical reaction; sodium atoms on the clay surface are replaced by the ammonium cations of a quaternary ammonuim salt. Other potential gelling agents have been made organophilic by the attachment of a long hydrocarbon chain (esterification with a long-chain alcohol to coat silicas; formation of metal N-substituted terephthalamates).

Combinations of nonsoap gelling agents with organic fluids (nonsoap greases) currently account for something less than 10 per cent of the total domestic grease market. There are, however, no substitutes for these nonsoap greases where grease lubrication is needed in the face of extreme temperatures, low pressures, or ionizing radiation. Because of their superiority in many ways, there is little doubt that certain of the nonsoap greases are destined to command a greater percentage of the over-all grease market.

Some nonsoap greases are even making inroads into the "multi-purpose" grease markets. Petroleum oils thickened with organophilic clays cost very little more than soap-type greases, and these clay-thickened greases are easier to manufacture. The organophilic clays are available preformed and are easily dispersed in the fluid by milling. This simple processing leads to reproducible quality, long sought in the grease industry with *in-situ*-formed soap processes.

Future Lubricant Developments

It is reasonable to expect that petroleum-derived fluids will continue to dominate the lubricating oil market for many years. To some degree, improved refining techniques may enable petroleum fluids to regain some of the markets which were lost to synthetic lubricants during the past ten years. On the other hand, improved methods for producing synthetic lubricants from inexpensive natural sources, and novel petrochemical processing techniques, could result in the more widespread use of synthetic fluids in moderate service applications. The development of synthetic fluids for use in high-temperature environments is rapidly reaching the point of diminishing returns. However, recourse to organometallic compounds could significantly increase the thermal stability "ceiling".

A steady increase in the use of solid lubricants is to be expected, especially if new materials, superior to graphite or molybdenum disulfide for moderate service applications are forthcoming. Such markets may well expand at the expense of the lubricating-grease market, the bulk of which has traditionally been assigned to automotive usage. The survival of the lubricating-grease industry may thus depend on its willingness to think in terms of new materials and more effective grease that can be sold on a performance rather than a price basis in the rapidly changing automotive market.

NEW MATERIALS FOR NEW DEVICES

"The technical competence of a country is reflected in the way it uses and converts nature's resources. Until recently the approach was an empirical one: materials were found, their macroscopic properties evaluated, their chemical constituents analyzed, and applications made after proper shaping and processing . . .

"All this is changing. Fundamental science—in decades of quiet studies on electronics, atoms, molecules, and their concerted action in gases, liquids, and solids—has reached the stage where a more powerful approach becomes possible: 'molecular engineering', the building of materials to order. We now begin to design materials with properties prescribed for the purpose in hand; we can understand, by observing the underlying molecular phenomena, why materials fail; we can build into the materials safeguards against such failures and get true criteria for ultimate performance. No longer shackled by available materials and empirical performance characteristics, we can dream up completely new devices."

Arthur von Hippel, Professor of Electrophysics, Massachusetts Institute of Technology.

NOTES from BATTELLE

✱ ROLL-WELDED SANDWICH PANELS

A method of producing corrugated-core sandwich panels that reduces costs has been developed in research sponsored by the Douglas Aircraft Company at Battelle. The method requires no jigging, provides completely sound core-to-core bonds, and allows the panels to be extensively formed after assembly.

The process—called roll-welding—uses hot rolling to pressure-weld the peaks of the corrugated metal core to the cover sheets.

Size of the sandwich panels is limited only by rolling-mill capacity. Quarter-inch thick panels as large as 36 by 72 inches have already been produced. Roll-welded sandwich panels have been made of 2014 aluminum alloy, B-120 VCA titanium, unalloyed A-55 titanium, steel, molybdenum, and Inconel.

Key Battelle metallurgists in the development of the process were Dr. Robert I. Jaffee, H. Russell Ogden, Dr. Dean N. Williams, Edwin S. Bartlett, and Jerry A. Houck. Douglas participants were Lewis H. Abraham, Mortimer J. Lowy, and Henry W. Babel.

To form the corrugated core, an accordion-pleated sheet of metal is woven over and under V-shaped inserts of a chemically soluble deformation-resistant metal such as copper or iron. A rectangular metal frame is placed around the core, and the face sheets of the sandwich are added. The entire assembly is clamped in place by two additional metal cover sheets which are welded to the rectangular frame. The whole package is then rolled parallel to the corrugations.

In addition to welding the core to both covers, rolling also reduces the thickness of the panel up to 60 per cent to provide desired corrugated shapes.

After rolling, the retaining frame is sawed or sheared off and the metal covers, which were welded to the frame, are peeled away. With the support wedges still in place, the sandwich panel can now be formed into a wide variety of shapes, including hemispheres, without buckling the core. Standard tooling can be used, and the panel can be worked as though it were a solid metal plate of equal thickness.

The V-shaped inserts are then leached out of the formed structure with a chemical reagent, such as nitric acid. Although the leaching process is time consuming for very large panels, it is a straightforward operation and is relatively inexpensive. If necessary, leaching can be accelerated by mechanical means.

Roll-welding can also be used to produce sandwiches with vertically ribbed cores, since core design is determined by the design of the filler wedges. The only limitation is that the core has to be unidirectional.

Roll-welded corrugated sandwich panels approach the all-round rigidity of honeycomb sandwiches, and are simpler and much less costly to manufacture.

✱ RELIABILITY IN INDUSTRY

Before American industry can achieve its current goal of greater product reliability it will have to answer two questions: What is reliability? How can you build it into a product? This is the view of Battelle reliability specialist Hall Cary in a paper presented before the Society of Automotive Engineers in Detroit.

Seeking to provide the answer to the first question, Cary says in his paper: "Reliability is a subjective term. When we say something is reliable, we mean we have confidence in it. It is dependable. Quite simply, a reliable device does what the customer expects it to do. It is the probability of successful performance for the length of time and under the conditions expected." For example, although an old car has more mechanical failures than a new car, the old car may be rated reliable simply because less is expected of it.

Cary says that separate reliability engineering groups are needed to attack the reliability problem; quality control cannot do the job alone. "The quality control man needs to answer the question: 'Does the product meet the requirements?' Reliability engineering needs data to answer the question: 'What should the product requirements be?' "

"When we practice quality control, we control the product to a specified level. The quality control group must have references. Where do quality references come from? They are set down in specifications, working drawings, and models by the engineering department. But the engineering department only translates the requirements into numbers or dimensions that can be used for control. The requirements come from many sources: from sales, from management, from accounting, and from the customer.

"At the source, the requirements may be stated only vaguely or not stated at all. If the task is to be done effectively, we must find ways to pinpoint what is ex-

pected of a product. To assign quality goals, we must find the happy compromise of economy, style, performance, and durability which will satisfy a high majority of customers. We must deal with statistics. Further, we must learn to translate statistics into quantified engineering specifications. Reliability is, after all, another factor which must be controlled, and it must be specified," says Cary.

Cary advocates the establishment of engineering committees with the responsibility for determining a product's reliability requirements. Such a committee, as envisioned by Cary, would be composed of people with various talents—statisticians, mechanical engineers, designers, and sales managers. They would get their information from the many existing engineering tests and, most important, from usage by the customers. They would observe, criticize, instruct, and influence, but do none of the actual engineering work. In brief, they would act as a corporate memory, keeping track of successes and failures and strengthening the designer's concept of good engineering practice.

* 1960—A SIGNIFICANT YEAR

Research sponsored at Battelle by industry and government in 1960 "was characterized by its depth in terms of potential significance to industry and to society," reports Dr. B. D. Thomas, Institute president. In summarizing the year's activities, he also points out that 1960 was a year of "modest growth" in dollar volume of research. The dollar volume at Battelle-Columbus—$23,450,000—was in fact an all-time high.

For Battelle, Thomas termed 1960 "a year of substantial progress toward our goals and aspirations". Among the indices noted in tracing this progress: (1) an increase in the science-orientation of its staff, (2) the improved caliber and number of fundamental studies supported by the Institute, (3) the creativity exhibited by staff members in their analytical approach to problems of industry, and (4) the increased number of patents and published writings of staff members.

Examples of Battelle research cited are studies directed toward more complete knowledge of the effects of radiation on the properties of materials, possible chemical treatments for cancer, a catalytic muffler to reduce smog-producing exhaust gases, an electrochemical metal-shaping process, and components for what will be the world's largest movable radiotelescope at Sugar Grove, West Virginia. Studies pertinent to nuclear energy and to space technology were numerous.

"One study was under way to determine how drivers are influenced by signals they receive from other automobiles—perhaps a prelude to later research more directly oriented to highway safety. This and other studies emphasize a trend worth noting: the merging of the physical sciences and the social sciences in research that affects whole blocks of people and whole regions. Other examples of this trend are an attempt now being made to understand better the effects of automation on men who supply the necessary human element in the complex man-machine systems, and a recently completed study of the resources of Alaska and Northwest Canada that will provide an economic basis for determining future transportation needs of the area."

The $23½ million in research at Battelle-Columbus was conducted for more than 650 industrial firms, associations, groups of companies, and government agencies. Additionally, the Battelle laboratories at Geneva, Switzerland, and Frankfurt, Germany, had research expenditures of $5 million. At the end of the year the staff at Battelle-Geneva totaled 374; at Battelle-Frankfurt, 547.

Dr. Thomas foresees a continuing upward trend in the volume of research conducted at Battelle. "The surest prediction that can be made concerning the future of research is that it will require an increasing number of the best minds. It is our intention that dedicated and qualified people will remain the Institute's major magnet in drawing our share of the nation's and the world's research effort."

* FEDERAL RESEARCH FUNDS FOR 1961

The Federal Government will obligate itself to spend an estimated $9.1 billion for the support of scientific research and development during fiscal year 1961, the National Science Foundation has announced. It estimates that $8.5 billion will be devoted to research and development and $600 million to increase of R & D plant. The 1961 figure reflects congressional action on the President's budget and subsequent administrative action.

As compared with the estimated 1961 total of $9.1 billion, obligations for 1960 were estimated at $8.6 billion, and the total for 1959 was $7.4 billion. Estimated expenditures for 1960 were $7.7 billion, and in 1959 actual expenditures were $6.2 billion.

In the current fiscal year, according to the NSF publication *Federal Funds for Research, IX*, the Department of Defense, the Atomic Energy Commission, and the National Aeronautics and Space Administration are

expected to administer about $7.6 billion, or 90 per cent of the total. Those agencies administered the same percentage in 1960.

Funds obligated in 1960 included an estimated $5.9 billion for development and $1.9 billion for total research. Of the latter, mathematical and engineering sciences accounted for 56 per cent, the life sciences 27 per cent, and the remaining 17 per cent was allotted to the psychological, social, and other sciences.

✱ REACTOR MATERIALS RESEARCH

The present status and future prospects of materials development for nuclear reactors to generate electricity was the subject of a recent presentation by Dr. Russell W. Dayton before the Joint Congressional Committee on Atomic Energy.

Referring primarily to pressurized-water reactors, he pointed out that the present high cost of electricity from nuclear reactors must be reduced—from 9 to 6 or less mills per kwhr—before reactors can become competitive with conventional fuel plants. Cost of all items—fuel charges, operation, maintenance, insurance, and fuel-cycle—are higher for nuclear than for conventional plants.

The Battelle scientist considers fuel-cycle costs as the heart of the present power-cost problem because fuel-cycle costs need the greater reduction, and because the amount of cost reduction cannot be predicted. Only experimental study will provide the necessary answers. Such study might approach reduction of fuel-cycle costs in such ways as the following:

- Reduce the cost of fuel burned by using plutonium recycle or spikes of fully enriched uranium for the uranium cycle or by using the thorium cycle. The thorium cycle seems promising and deserves more attention.

- Lower the lease cost of fuel by producing more power from each pound of fuel and by decreasing fuel inventory through increasing neutron economy. Thus, thinner plates of UO_2 generate 2½ times as much power as the fuel in PWR Core 1, lowering the lease charge 60 per cent.

- Decrease fabrication costs by cheaper fabrication methods, use of lower cost materials, and longer life for fuel elements.

Additional research on structural materials for reactors is also needed. Technologists must be able not only to understand the effects of radiation upon the materials, but to control the effects so as to prevent adverse changes in the materials.

Yet research should not be limited rigidly to obvious needs. Breakthroughs result by giving good scientists enough freedom to provide promising and revolutionary solutions to problems and to carry them through to the point where administrators can be convinced of the promise of the new ideas.

The materials research program should be accelerated, in Dayton's view. More speedy solutions are needed, but the problems are far more difficult than most of those being tackled in other materials fields; reactor materials are generally new ones with very poor mechanical and chemical properties which must be studied for totally new properties. Thus, even with unlimited funds and personnel, the problems cannot be solved overnight. At the same time, an expansion of the materials research program by 50 per cent appears desirable, he stated.

Even if it is decreased in size, the materials program should not be changed significantly in type. The AEC has achieved a good balance between research on basic problems, applications, and development, and this balance should not be disturbed.

The scientist also commented that duplication in materials research is not a serious problem and that no steps should be taken which would stifle the initiative of scientists by centralizing and controlling all studies. So far as information exchange is concerned, information on research in progress should continue to be distributed promptly to all who can use it. Such exchange is satisfactory in the United States; but U. S. scientists must be more aware of what European scientists are *doing* now, not just what they are publishing.

✱ EXTRUDING TITANIUM FITTINGS

Production of titanium fittings by machining, the method currently in use, has been so costly that use of the fittings has not been justified. Recently, however, low-cost manufacture of titanium fittings has been made possible with precision cold-extrusion techniques. The techniques were developed at Battelle for the Manufacturing and Materials Technology Division, Air Materiel Command Aeronautical Systems Center, U. S. Air Force. Key Battelle metallurgists in the development were Robert J. Fiorentino, Paul D. Frost, and Albert M. Sabroff.

Full-size cups for No. 10 hexagonal nuts were backward extruded in a single operation from solid cylindrical AMS 4902 unalloyed titanium billets 1-inch in di-

ameter by ⅝-inch thick. The extruded cups, measuring 1-inch across the flats by 1-inch long with 25/32-inch bore, were then finish machined and threaded on a screw machine. Such nuts are normally produced in steel or aluminum on automatic screw machines.

The starting billet used in cold extrusion is only half the weight of the one needed for screw machining; it also can be cut from round barstock instead of the more expensive hexagonal barstock. Material cost of the nut produced by cold extrusion with screw machine finishing amounts to $.64 compared to $1.52 for a nut produced exclusively by screw machining operations. Comparing over-all manufacturing costs, there is a net cost saving of 48.5 per cent over the conventional methods of making the titanium nut completely by screw machine methods. In addition to significant cost savings on material and labor, the cold extrusion process also offers the advantages of (1) considerable strengthening through work hardening and (2) excellent surface finishes and close dimensional control in the as-extruded condition. According to Frost, other hydraulic fittings and female fasteners should be adaptable to fabrication from titanium by cold extrusion, making titanium parts more competitive with other metals.

The aim of the current program was to establish the necessary basic technology for cold extruding actual parts from titanium on a commercial basis. The studies were directed mainly toward reducing the pressure requirements. The variables studied were punch design, billet shape, and lubrication.

* HIGH-TEMPERATURE OXIDANTS

The building of more compact and increasingly powerful aircraft gas-turbine propulsion units is increasing the need for improved lubricants capable of providing effective lubrication at high temperatures under oxidizing conditions. Fluids stable to 500 F will be in demand by engine builders in the near future.

A Battelle study of organoselenium compounds for the Selenium-Tellurium Development Committee has contributed to knowledge in this field. Chemists Ray L. Dueltgen, Myron N. Lugasch, and Stanley L. Cosgrove recently reported on their study before the annual meeting of the American Society of Lubrication Engineers. The research was designed to increase understanding of the relationships between the additive structures, antioxidant effectiveness, and corrosiveness of various compounds.

These observations grew out of the research:

- Ester, silane, and silicone fluids containing organoselenium of diverse chemical structure and 0.49 per cent selenium, are corrosive to copper, silver, magnesium, and aluminum during oxidation at 425 F or above.
- These additives vary widely in their ability to inhibit oxidation, but in many cases those more effective as inhibitors are also more corrosive.
- For reasons not fully understood, several para-substituted diphenyl selenides are better antioxidants for ester fluids than is diphenyl selenide itself.
- Diphenyl diselenide is a promising antioxidant in ester fluids, and it performs even better when mixed with p-cyanophenylphenyl selenide.
- Several substituted benzoselenadiazoles—5 dimethylaminobenzo (2,1,3) selenadiazole especially—are effective antioxidants for ester lubricants. Unfortunately, all studied are quite volatile at 425 F.
- For gas-turbine lubricant systems not containing copper, silver, aluminum, or magnesium, p-aminophenylphenyl selenide, 5-dimethylaminobenzo (2,1,3) selenadiazole, and diphenyl diselenide are as effective antioxidants as "5,10,10" + PANA.
- Polyesters of MIL-L-9236 base-stock quality are more susceptible to inhibition by diphenyl selenides and benzoselenadiazoles than are diester fluids.
- With minor exceptions, additives that are most effective in controlling viscosity increases during oxidation of esters are also most effective in minimizing acid formation. This relationship approaches linearity for substituted benzoselenadiazoles in ester fluids.

BATTELLE STAFF MEMBERS recently named to technical posts include: *Stanley L. Cosgrove*—secretary, Committee on Bearings and Bearing Lubrication, American Society of Lubricating Engineers; *Winston H. Duckworth*—secretary-treasurer (1961-62), National Institute of Ceramic Engineers; *J. Harry Jackson*—chairman, Institute of Metals, Metallurgical Society, American Institute of Mining, Metallurgical and Petroleum Engineers; *Richard L. Jentgen*—member, Fundamental Research Committee, National Lubricating Grease Institute; *Richard J. Lund*—member, Program Policy Committee *and* member, Mineral Economics Committee, Society of Mining Engineers AIME; *David C. Minton*—member, Research Committee, National Association of Manufacturers; *Perry L. Rieppel*—district director, American Welding Society

Writings by STAFF Members

The following papers appeared in "Saline Water Conversion", *Advances in Chemistry Series*, No. 27, 1960. American Chemical Society, Washington, D.C.

Field Evaluation of Solar Sea Water Stills. Construction methods and performance data are presented on solar sea water stills under evaluation at the Florida Solar Distillation Research Station. Three stills representing two basic designs have been constructed and operated there: a 2500-sq.-ft. glass-covered deep-basin still and 2300- and 500-sq.-ft., air-supported plastic stills. ***J. W. Bloemer, R. A. Collins, and J. A. Eibling.*** pp. 166-177.

Corrosion of Metals in Sea Water. The Office of Saline Water is directing a large number of investigations into the feasibility of new processes for producing fresh water starting with sea or brackish water as a source. It is desired that these plants last for 20 years or more. This paper points up ways in which the economic waste resulting from corrosion in saline water plants can be avoided. The article is based on a review of the corrosion literature and on consultations with marine experts in the field. Of the many materials for distillation plants, steel is the most important. It can be used to handle sea water below 250 F, if proper steps are taken such as the removal of all air (oxygen) from solution. For severe service and better performance, metals such as Ti, Hastelloy C, Monel, cupro-nickels, Al, aluminum brass, or Admiralty brass are used. ***Frederick W. Fink.*** pp. 27-39.

Centrifugal Phase-Barrier Recompression Distillation. A laboratory still at Columbus, Ohio, has been used for basic studies of the parameters that influence the evaporating and condensing heat transfer coefficients of a rotating surface. The estimated cost of distilling 50,000 to 100,000 gallons per day with the Hickman process is between $1.75 and $1.20 per 1000 gallons, depending mainly on the useful life assigned to the evaporator. ***K. C. D. Hickman, W. J. Hogan, J. A. Eibling, and W. L. Buckel.*** pp. 128-146.

Water Purification by Zone-Freezing. The economics of purification of saline water by zone-freezing were investigated using analog simulation as a tool to optimize the design. Estimated costs for the process were found to be too high to make it competitive with other processes now under development. ***William H. Mink, George F. Sachsel, and R. B. Filbert, Jr.*** pp. 75-81.

Investigations of Rare-Earth Oxide Cathodes. The thermionic emission from a mixture of 75% neodymium oxide and 25% gadolinium oxide was studied. The oxide mixture was applied to rhenium and to undoped tungsten electrophoretically. Heating the oxides on undoped tungsten wires to temperatures of about 1300 C (brightness) or above resulted in permanent reduction of the emission capabilities. On the other hand, heating the oxides on rhenium wires to temperatures up to 1540 C temporarily improved the emission. ***J. B. Baker and G. B. Gaines.*** PB 150424; *Scientific Report No. 3*, May 1, 1960, 9 pp. (LC mi $1.80, ph $1.80).

Operation and Maintenance of An In-Pile Gas-Cooled Loop at the BRR. A circulating-gas loop was operated 5574 hr. in-pile at the Battelle Research Reactor to evaluate fuel materials and to obtain engineering data for the GCRE and ML-1. In the final design, 200-psig N-0.5 volume per cent O could be circulated at a rate of 1500 lb. per hr. through a 1.5-in.-ID by 24-in.-long instrumented test section to provide a heat-removal capacity of around 50 kw. ***Sam J. Basham and William G. Rieder.*** U.S. Atomic Energy Commission, *BMI-1485*, Dec. 14, 1960, 25 pp. (OTS $0.75).

A Study and Development of the Hickman Sea-Water Still. The fundamental studies were especially necessary because evaporation and condensation on a rotating heat-transfer surface is a new art; it was particularly desirable to determine the conditions under which rotating disks could be wetted with the thinnest possible films, and the maximum heat-transfer coefficients that could be obtained with rotating disks. As a corollary of this study, the factors governing the economic potential of the distillation process have been reasonably well defined. ***W. L. Buckel, et al.*** PB 171030; *Saline Water Research and Development Progress Report* No. 43, Sept. 1960, 152 pp. (OTS $3.00).

Effects of Ternary Additions on Aluminum-35 w/o Uranium Alloys. The effects of a number of additions on the constitution, casting, and fabricating characteristics were investigated. Initial investigations were concerned with the effects of 3 a/o ternary additions on the microstructure and press-forging characteristics of the alloy. It was found that additions of this magnitude often introduced extrinsic phases in the alloy. At the 3 w/o level, additions of Ge, Si, Sn, or Zn inhibited the formation of UAl_4 and thereby increased the extent of the aluminum matrix in the alloy. It was also noted that these additions decreased the pressures required for extruding, and the tin addition also improved the homogeneity of cast shapes. Lead and Pd also improved the homogeneity of the cast material; however, neither of these was an effective inhibitor of UAl_4 and free lead was detected in the alloy to which lead had been added as the ternary. ***Norman E. Daniel, Ellis L. Foster, and Ronald F. Dickerson.*** U.S. Atomic Energy Commission, *BMI-1388*, Oct. 27, 1959, 34 pp. (LC mi $3.00, ph $6.30).

VMR Critical-Assembly Studies. The critical-assembly core consisted of 37 hexagonal, stainless steel fuel-element cans, each containing 61 fuel pins. The fuel pins were 0.485-in.-OD aluminum tubing (0.028-in. wall) filled with UO_2 pellets, 0.415 in. in diameter and 1.80 per cent enriched. Fuel pins and elements were arranged in triangular lattices. Core configurations that were combinations of 0.633- and 0.703-in. pin pitches and 5.54-, 5.95-, and 6.34-in. element pitches were investigated. Light water served as the moderator, while water, furfural, furfuryl alcohol, and air were used within the fuel elements as coolant-simulating materials. In the various core configurations measurements were made of nuclear parameters related to thermal-flux disadvantage factors, resonance-escape probability, fast effects in uranium-238 and uranium-235, and effective neutron temperatures. Critical configurations, reactivity worth of liquid levels, core temperature coefficient of reactivity, and flux and power distributions were also obtained. ***Richard A. Egen, Lee H. Bettenhausen, William S. Hogan, David A. Dingee, and Joel W. Chastain.*** U.S. Atomic Energy Commission, *BMI-1482*, Dec. 2, 1960, 60 pp. (OTS $1.50).

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Design Information on 17-7 PH Stainless Steel for Aircraft and Missiles. Elevated-temperature design curves for short-time ultimate tensile strength, tensile yield strength, compressive yield strength, ultimate shear strength, bearing ultimate strength, and bearing yield strength are presented. ***R. J. Favor, O. L. Deel, and W. P. Achbach.*** PB 151096; Defense Metals Information Center, *DMIC Report No. 137*, Sept. 23, 1960, 37 pp. (OTS $1.00).

Investigation of Bessemer Converter Smoke Control. A 300-lb. experimental Bessemer converter was assembled to simulate blowing conditions in a commercial vessel. Measurements of smoke and dust were also made in the field on a 30-ton commercial vessel. During normal blows the dust loading from the laboratory converter averaged 0.51 lb. per 1000 lb. of exhaust gas. This was similar to the exhaust-gas loading of a commercial vessel. The addition of hydrogen to the blast gas of the laboratory converter caused a decided decrease in smoke density. Smoke was also reduced markedly when methane or ammonia was added instead of hydrogen. The research is continuing on a bench-scale investigation of the mechanism of smoke formation in the converter process. ***A. R. Orban, J. D. Hummell, and R. B. Engdahl.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, No. 6, Dec. 1960, p. 1039-1049.

The Effects of Chemical Impurities on the Quality of Rolled Uranium Rod. Thirty-four uranium ingots containing controlled amounts of carbon, nitrogen, and MgF_2 slag were cast, rolled, and examined to investigate the relation between these impurities and the quality of the rolled rod. Carbon in concentrations up to 1400 ppm and nitrogen up to 170 ppm, either singly or in combination, had no significant effect on the number of defects observed in the rolled rod. The quality of the rods, however, decreased with increasing amounts of slag. The amount of slag necessary to cause observable differences in the rod could not be detected on analysis, but was visible in the microstructure. ***H. A. Saller, J. R. Keeler, and L. J. Cuddy.*** U.S. Atomic Energy Commission, *BMI-952*, Oct. 1, 1954, 24 pp. (LC mi $2.40, ph $3.30).

The Effect of Radiation on Selected Properties of Spherical Graphite Fuel Elements. As part of the fuel-element-evaluation program for the Pebble-Bed Reactor, 1.5-in. diameter graphite spheres fueled with UO_2, UC_2, and UC particles were irradiated at 1300 to 1700 F to uranium-235 burnups of 1.6 to 8.6 a/o. The study included bare graphite spheres and spheres coated with siliconized silicon carbide and pyrolytic carbon. Of the six coated spheres, only two, coated with silicon carbide, did not have cracks in the coating after irradiation. The uncoated graphite spheres contracted. Diameters decreased 0.2 to 0.9%. These decreases are not easily correlated with burnup. Highly graphitized spheres showed more contraction than spheres containing less-ordered carbon structures. ***Allison K. Smalley, Richard J. Burian, Arnold F. Gerds, Gilbert E. Raines, and Ward S. Diethorn.*** U.S. Atomic Energy Commission, *BMI-1483*, Dec. 2, 1960, 21 pp. (OTS $0.50).

The History and Scope of High Energy Rate Forming. In the context of today's concepts high-energy-rate forming encompasses forming by means of explosives, expanding gases, spark-discharge, and transient magnetic fields; in addition, the more common metalworking processes, including wire-drawing, rolling, extrusion, or forging, can be included in the term when they are carried out at much higher rates than has been customary in the past. High-energy-rate processes are applicable to a large variety of metal forming jobs, although forming of flat products and tubular shapes into specific parts has been the principal area of importance up to now. ***H. J. Wagner and A. M. Sabroff.*** SP60 - 104; Paper from *Creative Manufacturing Seminars, 1960-1961*, 15 pp., 1960. American Society of Tool and Manufacturing Engineers, Detroit, Mich.

Recent Developments in Superalloys. A significant expansion of the operating limits of superalloys has been brought about in the past few years with the development of over a dozen new nickel-base and cobalt-base materials. Some of these alloys are fabricable into sheet, while others are suitable only for precision casting. The purpose of this memorandum is to highlight some of the newer superalloys and to discuss some of their important properties and characteristics. ***H. L. Wagner.*** PB 161214; Defense Metals Information Center, *DMIC Memorandum 64*, Sept. 8, 1960, 14 pp. (OTS $0.50).

Tables of Tolerance-Limit Factors for Normal Distributions. Tables of factors for use in computing two-sided tolerance limits are presented. In contrast to previous tabulations of the tolerance-limit factor K, one can tabulate the factors $r(N, P)$ and $u(f, \gamma)$, whose product is equal to K. This results in greatly increased compactness and flexibility. The mathematical development is discussed, including methods used to compute the tabulated values and a study of the accuracy of the basic approximation. A number of possible applications are discussed and examples are given. ***Alfred Weissberg and Glenn H. Beatty.*** *Technometrics*, v. 2, no. 4, Nov. 1960, p. 483-500.

Magnetoresistance in Gallium Arsenide. The transverse magnetoresistance in n-type gallium arsenide was studied as a function of impurity concentration and density of defects introduced by fast-neutron irradiation. The data are consistent with theoretical predictions based on mixed scattering and a spherical-energy-surface model. The change in the magneto-resistance with fast-neutron bombardment suggests the introduction of levels other than the deep-lying ones revealed by changes in the carrier concentration and that some of these levels may be multiply ionized. ***R. K. Willardson and J. J. Duga.*** *Physical Society, Proceedings*, v. 75, 1960, p. 280-290.

Fission Fragments Initiate Ethylene Glycol Synthesis. Irradiation of methanol by fission fragments gives 0.1 lb. of ethylene glycol per kwh with 65% chemical conversion. Methanol irradiation experiments were designed to show the effects of temperature, dilution with water, and addition of carbon tetrachloride. Six methanol-vapor samples were irradiated in Argonne's CP-5 reactor and 12 samples in the reactor at Battelle Memorial Institute. It was found that: (a) for irradiations of undiluted methanol, raising the temperature to 250 C had little effect on glycol yield and energy requirements; (b) raising conversion to 15% adversely affected chemical yield and energy input; (c) diluting the methanol with 50 mole % water raised the glycol yield to 67% but did not affect the energy required per pound; and (d) adding 1% CCl_4 to undiluted methanol increased the yield to 66% while reducing energy needed to 4.2 kwh/lb of glycol. Irradiations at Battelle showed that low concentrations of carbon tetrachloride markedly raised yields. Tables compare the results of the experiments conducted at the CP-5 and Battelle reactors. ***Allan K. Wiebe, Willard P. Conner, and Glenn W. Kinzer.*** *Nucleonics*, v. 19, Feb. 1961, p. 50-52.

Electrodeposition of Chromium Alloys and Study of Elevated-Temperature Properties of Certain Electrodeposited Metals and Alloys. Describes elevated-temperature oxidation studies of electrodeposited metals in liquid- and vapor-phase molybdenum trioxide. Another objective was to determine the effect of changing the composition of chromium-iron alloy on its coefficient of thermal expansion and permanent change in length after heat treatment. The expansion and contraction behavior of electrodeposited cobalt-tungsten alloy and of a specimen of stress-free nickel was also investigated. ***P. T. Woodbury, W. G. Hespenheide, et al.*** PB 148736; *Technical Progress Report No. 4*, February 15, 1955, 28 pp. (LC mi $2.70, ph $4.80).

Effect of High Pressure on Electrical Properties of NiO, CoO and Cu_2O. The effect of pressure on electrical resistance and Seebeck coefficient at or near room temperature was determined. Equations relating the Seebeck coefficient to hole concentration were used to calculate the effect of pressure on hole mobility. In all materials examined, hole mobility was decreased by pressures to 60,000 atm. It is proposed that in NiO, CoO and CuO, the decreased hole mobility with pressure was due to a decrease in diffusion rate of self-trapped holes. The explanation for pressure effects in Cu_2O may be more complicated since Cu_2O is generally regarded as a wide band semiconductor. ***P. Young, W. B. Wilson, and C. M. Schwartz.*** PB 150200; *Technical Note No. 1*, Sept. 1, 1960, 27 pp. (LC mi $2.70, ph $4.80).

BATTELLE TECHNICAL REVIEW

ABSTRACTS

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ADMINISTRATION AND PHILOSOPHY OF RESEARCH

a

Industrial R & D Outlays Hit $10 Billion. Chemical industry continues to pace all other industries in outlays for industrial basic research. In 1959, it spent $98 million of the total $344 million spent by all U. S. industry for that purpose. *Chemical & Engineering News*, v. 39, no. 4, Jan. 23, 1961, p. 23.

b

* **Research Scientist, Care and Feeding Of.** Presents key questions for research managers in evaluation of their research facilities preparatory to designing goals and objectives for the future. ***Jack W. Dunlap.*** *Mining Congress Journal*, v. 47, Jan. 1961, p. 55-57.

c

Industrial Research and Development. Discusses three major decisions of strategy to take in scientific work: what to start, when to stop, and where to go. *Nature*, v. 188, Dec. 24, 1960, p. 1055-1058.

Research Costs. Discusses trimming research costs while preserving and expanding research output. *Chemical Week*, v. 88, no. 5, Feb. 4, 1961, p. 57-61.

d

AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

A Method to Investigate Kinetic Heating at Very High Velocities in an Intermittent Wind Tunnel. Presents a general method to investigate the aerodynamic heating problem by testing small model at blow-down supersonic and hypersonic wind tunnel. The method is particularly suitable for University-type supersonic wind tunnel. Preliminary results on turbulent heat transfer on axiallysymmetric blunt doby are herewith given. (*In Italian.*) Una tecnica per lo studio alla galleria aerodinamica intermittente dei fenomeni di riscaldamento cinetico sui corpi alle altissime velocità. ***Luigi Broglio.*** *Aerotechnica*, v. 40, no. 5, Oct. 1960, p. 259-262.

e

f

* **The Aerodynamic Forces Associated With Harmonic Motion of Slender Wings on Stationary Bodies of Revolution.** The uniform body is circular in cross section, the wings are placed symmetrically and the wing deformation mode is necessarily symmetrical about a vertical plane through the body axis. The frequency parameter is restricted to that range for which the "cross-flow" potential equation is Laplace's equation. ***R. D. Milne.*** *Aeronautical Quarterly*, v. 11, pt. 4, Nov. 1960, p. 355-370.

g

* **Boundary Layers Over Infinite Yawed Wings.** A method of calculating turbulent boundary layers on infinite yawed wings is given, making use of a method of calculating turbulent boundary layers due to Spence and of an analogy between three-dimensional and axi-symmetric boundary layers. It is also shown that the displacement thickness is equal to that computed using chordwise components. ***J. C. Cooke.*** *Aeronautical Quarterly*, v. 11, pt. 4, Nov. 1960, p. 333-347.

h

* **The Quasi-Cylinder of Specified Thickness and Shell Loading in Supersonic Flow.** The analysis deals with a generalized quasicylinder; that is one which, although lying close to a mean cylinder, need not possess axial symmetry. Because the linearized theory is inadmissable for internal duct flows close to and beyond the first reflected characteristic cone, the present solution is likewise invalid close to and beyond the position where this characteristic meets the mean cylinder. ***H. Portnoy.*** *Aeronautical Quarterly*, v. 11, pt. 4, Nov. 1960, p. 387-395.

i

* **Thermal Equilibrium of Space Vehicles.** Before a space vehicle is launched, the temperatures that it will reach in space must be predicted. The temperature of an earth satellite under various conditions is calculated from what is known of the environment. ***David Bushnell and Allan D. Kraus.*** *Sperry Engineering Review*, v. 13, no. 4, Dec. 1960, p. 26-35.

j

k

* Asterisks mark items that may be used in the Battelle Library only. None of the unbound materials listed are available for interlibrary loan.

Viscous Flow Past a Quarter-Infinite Plate. A study is made of the motion of an incompressible viscous fluid past a quarter-infinite plate, whose leading edge is perpendicular to and whose side edge is parallel to the undisturbed direction of the stream. It is assumed that the kinematic viscosity v is small. The first approximation is taken to be the undisturbed motion, and successive approximations are obtained by iteration. The second approximation is the Blasius shear layer necessary to satisfy the boundary conditions on the plate. ***K. Stewartson.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 1-10.

Stability of Partially Controlled Motions of an Aircraft. Based on the actual situation that the aircraft and the pilot form a single dynamic system, which as a whole must be stable (while the machine alone may be an unstable component of the flying system), this paper presents a method for approaching the problems of the stability of the partially controlled motions of an aircraft. The forces and moments brought into play by the pilot's continuous intervention appear as random and unknown, but are nevertheless susceptible of approximate evaluation. The assumption is made that their order of magnitude is determined by the bounds within which the pilot is able to restrain the deviations he counteracts. Hence these forces and moments are small, provided that the above-mentioned bounds are sufficiently small. The problem is solved in principle, on the basis of stability under continuously acting disturbances. Then the theory is applied to a few particular cases of longitudinal and lateral stability of aircraft. ***T. Hacker.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 15 + 12 pages.

Experimental Investigation of the Downstream Influence of Stagnation-Point Mass Transfer. Presents results of an experimental investigation of localized mass transfer in the stagnation region of a blunt body under hypersonic flow conditions. The coolant is injected through a porous plug coaxial with the centerline of symmetry of the model. The tests were carried out in a wind tunnel with a Mach number of 6.0, stagnation temperatures of approximately 1600 R, and a stagnation pressure of approximately 600 psia. Four different gases were injected over a range of mass flows. The heat transfer on the impermeable section was measured under isothermal wall conditions; for the higher rates of mass flow, adiabatic surface temperatures were also determined. ***Paul A. Libby and Robert J. Cresci.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 51-64.

On the Approach to Chemical and Vibrational Equilibrium Behind a Strong Normal Shock Wave. The concurrent approach to chemical and vibrational equilibrium of a pure diatomic gas passing through a strong normal shock wave is investigated. It is demonstrated that the equilibrium degree of dissociation behind the shock front, and hence the density, for the case where the vibrational degrees of freedom are frozen out can exceed the degree of dissociation, and hence the density, for the case where all degrees of freedom are in equilibrium. Thus the necessary condition for a maximum of the density between the shock front and the position of full equilibrium flow downstream of the shock front is established. ***William H. Dorrance.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 43-50.

Inviscid-Incompressible-Flow Theory of Static Peripheral Jets in Proximity to the Ground. An "exact" flow theory of peripheral jets issuing symmetrically from a hovering aerial-ground vehicle is presented. The theory is exact insofar as no simplifying assumptions were made in obtaining a solution of the governing inviscid, two-dimensional hydrodynamical flow equations. The results are valid for all jet thickness/vehicle height ratios. The limit of applicability of existing theories (very low thickness/height ratios) are defined. Jet reaction, lift, and power coefficients for static conditions are introduced and computed. Lift augmentation and lift/power ratios are also calculated. Applications to three-dimensional vehicles with rotational symmetry are indicated. ***T. Strand.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 27-33.

* **Modern Cargo Aircraft Design.** Analysis of the effect of cargo density on the design and operation economics of the all cargo aircraft. Describes the mechanized cargo handling system, developed by Canadair Ltd. for the CL-44, and analyzes the effect of mechanization on operating profit in a typical transcontinental operation. ***E. H. Higgins.*** *Canadian Aeronautical Journal*, v. 7, no. 1, Jan. 1961, p. 3-12.

* **Interpretation of Probe Pressures and Some Associated Problems at Very Low Densities.** Points out certain phenomena associated with the measurement of low pressures, discusses the interpretation of probe pressures and describes briefly the properties and uses of free molecule flow pressure probes that have been developed recently. A short review of various pressure measuring devices used in low density work is also included. ***G. N. Patterson and A. K. Sreekanth.*** *Canadian Aeronautical Journal*, v. 7, no. 1, Jan. 1961, p. 13-18.

Theoretical Investigations of the Ablation of a Glass-Type Heat Protection Shield of Varied Material Properties at the Stagnation Point of a Re-Entering IRBM. The melting-type heat protection is treated by employing homogeneous, opaque, and nondecomposing glass shields which do not exceed a temperature of 460 K at their thermally insulated inner edges. The performance of 36 different glass shields with assumed combinations of material properties is investigated by employing a calculation method which yields practically exact, transient solutions for the problem. As a corollary, results for a certain steady flight state are also given. The discussions made it possible to derive under realistic flight conditions some thermal characteristics for the employment of thin, or lightweight, glass shields. ***Ernst W. Adams.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-564*, Jan. 1961, 64 pp. (TL570 Un3t Room 290)

Development of the Lunar and Solar Perturbations in the Motion of an Artificial Satellite. Problems relating to the influence of lunar and solar perturbations on the motion of artificial satellites are analyzed by an extension of Cayley's development of the perturbative function in the lunar theory. In addition, the results are modified for incorporation into the Hansen-type theory used by NASA Space Computing Center. The theory is applied to the orbits of the Vanguard I and Explorer VI satellites, and the results of detailed computations for these satellites are given together with a physical description of the perturbations in terms of resonance effects. ***P. Musen, A. Bailie, and E. Upton.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-494*, Jan. 1961, 44 pp. (TL570 Un3t Room 290)

Heat-Transfer Measurements on the Apexes of Two 60° Sweptback Delta Wings (Panel Semiapex Angle of 30°) Having 0° and 45° Dihedral at a Mach Number of 4.95. The laminar heat-transfer distributions (ratio of local to stagnation-line heating rate) about the models normal to the cylindrical leading edges were in close agreement with two-dimensional blunt-body theory. Comparison of heating rates on the two models at equal angles of attack and equal lifts demonstrated the reduction in stagnation-line heating that may be realized when large dihedral is incorporated into a 0° dihedral swept wing. The tests were conducted at a Mach number of 4.95 and a stagnation temperature of 400 F. ***Charles R. Gunn.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-550*, Jan. 1961, 51 pp. (TL570 Un3t Room 290)

Heat-Transfer Measurements at a Mach Number of 4.95 on Two 60° Swept Delta Wings With Blunt Leading Edges and Dihedral Angles of 0° and 45°. The laminar-flow-heat-transfer distribution (ratio of local to stagnation-line heating rate) around the wing normal to the leading edge and the stagnation-line heat-transfer level were compared with two-dimensional blunt-body theory. A comparison was made of the heat-transfer levels to the two wings at equal angles of attack and equal lifts. The tests were conducted at a stagnation temperature of 400 F, and the test-section unit Reynolds number was varied from 1.95×10^6 to 12.24×10^6 per foot. The angle of attack was varied from 0 to 20° for the two configurations. ***P. Calvin Stainback.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-549*, Jan. 1961, 50 pp. (TL570 Un3t Room 290)

On the Motion of a Satellite in an Asymmetrical Gravitational Field. Tracking precision and observation intervals of existing satellite data are sufficient for determining only the zonal harmonics in the geoid. With the availability of more accurate data extending over longer time intervals, it will become possible to determine also the tesseral harmonics in the gravitational field. The theory presented here was developed in anticipation of this fact; it extends the author's recently published work to permit easy inclusion of the influence of

tesseral harmonics, and of gravitational anomalies in the theory of the artificial satellite. ***P. Musen.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-569,* Jan. 1961, 20 pp. (TL570 Un3t Room 290)

A Method of Estimating Residuals in Orbital Theory. The degree of approximation used in determining the orbits of earth satellites is reflected in the residuals (differences between calculated and observed positions). The least-squares procedure generally used to fit theory to observation tends to obscure the significance of theoretical parameters, so that the physical sources of residuals cease to be apparent. A method is outlined for estimating the magnitude of the residuals to be expected from an approximation theory presumed to have one missing or incorrect term. ***Myron Lecar.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-493,* Jan. 1961, 10 pp. (TL570 Un3t Room 290)

An Investigation of Wing and Aileron Loads Due to Deflected Inboard and Outboard Ailerons on a 4-Percent-Thick 30° Sweptback Wing at Transonic Speeds. The model was a sting-mounted wing-body combination, and pressure measurements over one wing panel and one inboard and two outboard ailerons were obtained for angles of attack from 0 to 20° at deflections up to ± 15°. Reynolds number was about 7.4×10^6 based on the wing mean aerodynamic chord. Positive deflections of the ailerons caused significant added loadings over those wing sections not spanned by the controls. The loading shapes over the ailerons are irregular and, therefore, would be difficult to predict by theory in the transonic speed range. ***Charles F. Whitcomb, Chris C. Critzos, and Philippa F. Brown.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-620,* Jan. 1961, 282 pp. (TL570 Un3t Room 290)

Response of a Helicopter Rotor to an Increase in Collective Pitch for the Case of Vertical Flight. A theoretical analysis, considering unsteady effects, shows that the response to collective pitch while in descending flight is largely dependent upon the rapidity of control application. Experimental tests confirm the theoretical results. ***Jean Rebont, Jacques Valensi, and Jean Soulez-Larivière.*** *U. S. National Aeronautics and Space Administration, Technical Translation, NASA TT-F-55,* Jan. 1961, 20 pp. (TL570 Un3tm Room 290)

Measured Pressure Distribution and Local Heat Transfer Rates for Flow Over Concave Hemispheres. The use of parachutes for recovery of equipment from very high velocity vehicles, such as missiles, has directed attention to the need for aerodynamic and heat transfer information associated with such high drag bodies. With this application in mind, a solid concave hemisphere, positioned in a subsonic flow, was studied. Plexiglas models were placed in water and in air streams, and by using straightforward flow visualization techniques it was determined that the flow in the cup was, in essence, a separate flow region. Quantitative measurements were made of the pressure distribution and local heat transfer rate over a Reynolds number range of 6000 to 89,000. The pressure on the inner surface of the hemisphere was found to be equal to the total pressure from the stagnation point to an angle of 75 deg, dropping somewhat at greater angles. The heat transfer was found to increase monotonically from the stagnation point to the edge. The overall dimensionless heat transfer may be given in the form $Nu_D/(Re_D)^{1/2} = 0.42$. ***J. C. Y. Koh and J. P. Hartnett.*** *ARS Journal,* v. 31, Jan. 1961, p. 71-75.

The Role of Entropy in the Aerospace Sciences. Reviews general principles, structure of shock waves, connections between entropy and shock waves, and chemical equilibrium and nonequilibrium states. ***Jakob Ackeret.*** *Journal of the Aero/Space Sciences,* v. 28, Feb. 1961, p. 81 + 15 pages.

Flight Investigation of Some Effects of a Vane-Controlled Gust-Alleviation System on the Wing and Tail Loads of a Transport Airplane. Results are given of an analysis of structural loads measured on a light transport airplane which was modified by the installation of a gust-alleviation control system designed primarily to reduce airplane longitudinal response to turbulent air and thus to improve passenger comfort. Several different gust-alleviation configurations were investigated and the effects of each system on the normal acceleration and loads of the airplane were determined. ***Russell L. Schott and Harold A. Hamer.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-643,* Jan. 1961, 32 pp. (TL570 Un3t Vis.)

a

An Analytic Extension of the Shock-Expansion Method. The problem is considered of calculating approximately the inviscid rotational flow field and pressure distribution about a smooth two-dimensional airfoil with sharp leading and trailing edges in a uniform supersonic or hypersonic stream. The assumption of a perfect gas is made, and the basic flow pattern for the analysis is taken to be given by the simple isentropic shock-expansion method with straight characteristics. An elementary characteristics treatment is discussed to show when the simple shock-expansion method should be satisfactory for computing the surface pressure distribution, and under what circumstances it may be expected to break down. ***George D. Waldman and Ronald F. Probstein.*** *Journal of the Aero/Space Sciences,* v. 28, Feb. 1961, p. 119-132.

b

Solution of Subsonic Nonplanar Lifting Surface Problems by Means of High-Speed Digital Computers. Method proposed is based on an approximate solution of the integral equation which represents the potential flow about a finite wing, with no restrictions beyond those necessary for linearization. After assuming the usual series representation of the wing surface vorticity distribution, the solution is achieved by approximating portions of the kernels of the transformed integral equation by single and double Fourier series and performing termwise integrations analytically. ***L. J. Kulakowski and R. N. Haskell.*** *Journal of the Aero/Space Sciences,* v. 28, Feb. 1961, p. 103 + 10 pages.

c

Theoretical Pressure Distributions on Wings of Finite Span at Zero Incidence for Mach Numbers Near 1. Extension of a method previously used for plane and axisymmetric flows yields numerical results for aspect ratios from zero to infinity for rectangular wings of two profile shapes. In this method the partial differential equation appropriate to the study of transonic flow is replaced by a nonlinear ordinary differential equation, consistent with the known properties of transonic flow and amenable to numerical methods. Asymptotic forms of this equation for high and low aspect ratio are given and analytic results are obtained for special cases. ***Alberta Y. Alksne and John R. Spreiter.*** *U. S. National Aeronautics and Space Administration, Technical Report, NASA TR-R-88,* 1961, 89 pp. (TL521 Un3ra Vis.)

d

* **Temperatures in a Cylindrical Satellite.** Formulas are derived for temperatures inside a cylindrical instrument package in which heat from power-dissipating components must be conducted through a bulkhead to the skin and radiated. Thermal design considerations are discussed for such a package with constant skin temperature and periodically varying skin temperature. ***James R. Jenness, Jr.*** *Astronautica Acta,* v. 6, no. 5, 1960, p. 241-246.

e

Design of Hypersonic Aircraft. Demonstrates the compromise between subsonic and hypersonic flight requirements for a particular configuration which has a relatively small aerodynamic center travel through the whole speed range, no pitch-up at low speeds to fairly large lift coefficients, and a high lift-drag ratio at subsonic speeds. Shows that the hypersonic lift-drag ratio has to be determined by the restraints which the aerodynamic heating problem imposes on the airplane design. ***Hans Multhopp.*** *Aero/Space Engineering,* v. 20, Feb. 1961, p. 8 + 4 pages.

f

Use of Satellites in Commercial Communications. Future global communications via orbiting satellites will present systems choice problems of economics or maintenance and displacement. Three types of systems are discussed; synchronous-orbit active satellite, nonsynchronous-orbit active satellite, nonsynchronous passive satellite. Satellite electronics and propulsion technology factors are also considered. ***Leonard Jaffe.*** *Aero/Space Engineering,* v. 20, Feb. 1961, p. 14 + 4 pages.

g

Hovercraft—Some Design Problems. Economically competitive hovercraft need not be as large as was once predicted. It would appear that the optimum size for the simple peripheral jet machine is of the order of only 100 tons. ***R. Stanton Jones.*** *Aero/Space Engineering,* v. 20, Feb. 1961, p. 16 + 9 pages.

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An Approach to Operational Features Desirable in a Militarily Acceptable GEM. ***Peter G. Fielding.*** *Aero/Space Engineering*, v. 20, Feb. 1961, p. 18 + 5 pages.

a

A Review of the Jet Flap. A detailed review is presented of the theoretical and experimental advances that have been made in the study of pure jet flaps, jet control and jet-augmented flaps. ***G. K. Korbacher and K. Sridhar.*** *Toronto University, Institute of Aerophysics, UTIA Review No.* 14, 161 pp. + 162 figures. (TL570 T64.84r Vis.)

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Rocket-Model Investigation of Lateral Stability Characteristics and Power Effects of a Jet-Engine Airplane Configuration With Tail Boom at Mach Numbers From 1.15 to 1.37. A flight test was made to determine the jet effects on the lateral stability of a single-engine airplane configuration. The configuration employed sweptback wing and tail surfaces. The horizontal tail was located ahead of the jet exit and the vertical tail was mounted on a tail boom extending above and behind the jet exit. The jet was provided by a rocket simulating a typical jet engine with afterburner operating. No appreciable power effects were indicated by the static and dynamic lateral stability derivatives derived from the motions or by the pressures measured on the vertical tail. ***T. Bradley Curry, Jr. and Norman L. Crabill.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-638*, Jan. 1961, 29 pp. (TL570 Un3t Vis.)

b

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An Analysis of Exact and Approximate Equations for the Temperature Distribution in an Insulated Thick Skin Subjected to Aerodynamic Heating. Exact and approximate solutions are obtained, and the results are compared to determine the ranges of applicability of the approximations. The approximations are found to be within 5% of the exact solution when the ratio of the thermal capacitance and conductance of the metal to that of the insulation are sufficiently large. The roots of the characteristic equation of the exact solution are generally applicable to the two-slab heat-transfer problem and are tabulated up to the first nine roots. ***Robert S. Harris, Jr. and John R. Davidson.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-519*, Jan. 1961, 33 pp. (TL570 Un3t Vis.)

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A Study of the Positions and Velocities of a Space Station and a Ferry Vehicle During Rendezvous and Return. A study is made of the families of nonthrusting ascent trajectories during rendezvous with an orbiting space station and the descent trajectories to the earth's atmosphere. Equations of motion are derived and results are shown for two typical orbits of the station (one circular and one elliptic orbit). Boundaries of launch (at time of booster burnout) and rendezvous conditions are given and the effects of delays in launch time are discussed. ***John M. Eggleston and Harold D. Beck.*** *U. S. National Aeronautics and Space Administration, Technical Report, NASA TR-R-87*, 1961, 82 pp. (TL521 Un3ra Vis.)

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Optimum Design of Insulated Compression Plates Subjected to Aerodynamic Heating. A method to determine the minimum weight design of insulation and load-carrying structure has been applied to insulated stressed-skin compression structures subjected to aerodynamic heating. Charts have been prepared for four materials and for the loading parameters associated with compressive yield, buckling, and postbuckling failure. Additional charts are presented for conditions where more than one failure mode governs. ***John R. Davidson and James F. Dalby.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-520*, Jan. 1961, 53 pp. (TL570 Un3t Vis.)

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Long Range Planning for Space Transportation Systems. Integrated space operations planning is based upon balancing the available resources with expected expenditures in the areas of research and development, facilities, payloads, and basic space transportation. Some system parameters effecting long-range planning for launch vehicles are discussed in detail. Trends in space transportation cost for earth-orbital, earth-lunar, and earth-planetary missions for the next decade are given, based on typical programs. ***H. H. Koelle.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-597*, Jan. 1961, 36 pp. (TL570 Un3t Vis.)

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Radiation From Hot Air and Its Effect on Stagnation-Point Heating. The heating of the stagnation region of a blunt body by radiation from the hot air in the shock layer is investigated for flight speeds up to 50,000 ft./sec. by using experimental shock-tube data, supplemented by theoretical estimates. Nonequilibrium effects which modify the radiation predictions at high altitudes (≥ 30 miles) are pointed out. The radiation is compared with the aerodynamic heating and is found to be important at high velocities (≥ 30,000 ft./sec.) and low altitudes (≤ 25 miles). For this flight regime the dominant radiation results from the capture of electrons by nitrogen ions. ***Bennett Kivel.*** *Journal of the Aero/Space Sciences*, v. 28, Feb. 1961, p. 96-102.

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The Supersonic Boom of a Projectile Related to Drag and Volume. ***I. L. Ryhming.*** *Journal of the Aero/Space Sciences*, v. 28, Feb. 1961, p. 113 + 6 pages.

h

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The Dynamics of Rolling Aircraft. Some modern aircraft have mass distribution characteristics which lead to peculiar behavior under certain extreme maneuver conditions. In particular, the so-called "roll inertia coupling effect" has been observed. This report presents an elementary analysis of the dynamic couplings between rigid- and flexible-body aircraft motions introduced by a rapid steady roll. It is shown that rotating elastic systems exhibit several types of instability and "subharmonic response," and these motions are explained. Some new stability criteria for high-speed aircraft are introduced. ***F. W. Niederfuhr.*** *Journal of the Aero/Space Sciences*, v. 28, Feb. 1961, p. 133 + 8 pages.

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Here's How the First U.S. Astronaut Will Survive in Space. The first U. S. man in space, housed in the Mercury capsule, will survive with the aid of a carefully engineered life support system. Proved components will keep him supplied with oxygen, while the temperature, pressure, and odor, CO_2, and moisture content of his surroundings, are closely controlled. ***Edward H. Olling and J. R. Barton.*** *SAE Journal*, v. 69, Feb. 1961, p. 68-73.

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Proceedings of Meeting on Problems and Techniques Associated With the Decontamination and Sterilization of Spacecraft. Recommendations resulting from the deliberations include: a body of related information be accumulated, standard operating procedures be established, acceptable limits of contamination be determined, NASA policy be clarified, new sterilizing agents be developed, compatibility studies be pursued, sterile manufacture of parts be investigated, and a working level group should be formed to implement recommendations and procedures. ***Jack Posner, editor.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-771*, Jan. 1961, 57 pp. (TL570 Un3t Vis.)

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AGRICULTURE

*** The Novosibirsk Union Conference on Microbiological Methods for Combating Pest Insects and Rodents.** Held from Mar. 30 to Apr. 1, 1960, this conference, organized by the Biological Institute of the Siberian Division of the Russian Academy of Sciences, covered reports of the following types: controlled variability of microorganisms, diagnosis of diseases in insects and rodents, preparation and application of microbial preparations, counteraction against diseases in useful insects. (*In Russian.*) Vsesoiuznoe soveshchanie v novosibirske po mikrobiologicheskim metodam bor'by s vrednymi nasekomymi i gryzunami. ***I. N. Gritsenko.*** *Mikrobiologiia*, v. 29, no. 6, Nov.-Dec. 1960, p. 936-937.

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*** Application of Co-Ral for Systemic Control of Cattle Grubs *Hypoderma lineatum* (De Vill.) and *H. bovis* (L.).** Sprays of 0.5% CO-RAL wettable powder in water applied to the entire body of the unweaned calves reduced warble infestation by 99.5% and gave significantly better control than similar treatments with CO-RAL emulsifiable concentrate. M. ***A. Khan.*** *Canadian Journal of Animal Science*, v. 40, no. 2, Dec. 1960, p. 114-118.

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*** Ingredient and Processing Interrelationships in Swine Feeds. I. Effects of Antibiotics, Protein Source and Wheat Bran on the Responses to Pelleted Feed. II. Effects of Antibiotics, Protein Source and Pelleting on the Response to the Inclusion of Wheat Bran. III. Effects of Wheat Bran, Pelleting and Protein Source on Responses to Dietary**

Antibiotics. On the whole there was no advantage due to pelleting. However, in the absence of bran and antibiotics, and particularly when no animal protein was involved, pigs fed pelleted feed gained faster and had better feed efficiency. Conversely, the inclusion of either bran or antibiotics was as effective as pelleting. With approximately isocaloric diets the inclusion of 10% bran resulted in a general increase of 6% in feed intake and 8% in digestibility of protein. The greatest effects were obtained with antibiotic-free, animal protein-free, meal-type rations. The growth and feed consumption response to antibiotics was generally favorable, but the greatest effects were observed on meal-type rations devoid of both animal protein and bran. ***A. D. L. Gorrill, J. M. Bell, and C. M. Williams.*** *Canadian Journal of Animal Science,* v. 40, no. 2, Dec. 1960, p. 83-106.

* **The Symbiotic Synthesis of Auxin by Legumes and Nodule Bacteria and Its Role in Nodule Development.** When subterranean clover (*Trifolium subterraneum L.*) plants were grown for three weeks over distilled water, tryptophan could be detected in the root medium of both sterile cultures and those inoculated with *Rhizobium trifolii* three days earlier. Auxin could be detected only in the inoculated medium. Since nodule bacteria produce auxin only in the presence of tryptophan, which is a probable precursor of IAA, it is suggested that the tryptophan exuded by clover roots is converted to IAA by nodule bacteria. ***N. P. Kefford, J. Brockwell, and J. A. Zwar.*** *Australian Journal of Biological Sciences,* v. 13, no. 4, Nov. 1960, p. 456-467.

* **Accommodation of Linkage in Mass Selection Theory.** Purpose of this paper is to develop a theory of mass selection which will accommodate not only linkage but will provide for different recombination frequencies in the two sexes. The theoretical aspects of the linkage problem are developed in three stages. ***B. Griffing.*** *Australian Journal of Biological Sciences,* v. 13, no. 4, Nov. 1960, p. 501-526.

Studies on Induced Variation in the Rhizobia. I. Defined Media and Nodulation Test Techniques. *E. A. Schwinghamer.* *Applied Microbiology,* v. 8, no. 6, Nov. 1960, p. 349-352.

* **Structure of the Starch Granule. II. Action of Various Amylases on Granular Starches.** Two general patterns of enzymatic solubilization were observed: an extensive erosion and fragmentation of corn and sorghum starches and their waxy counterparts, and a selective granule-by-granule destruction of potato and most of the other starches. Even after 50% solubilization of corn and sorghum starches, the fragmented residues have iodine affinities, intrinsic viscosities, Brabender viscosities, and swelling and solubility patterns similar to those of the parent starches. ***Harry W. Leach and Thomas J. Schoch.*** *Cereal Chemistry,* v. 38, no. 1, Jan. 1961, p. 34-46.

Annual Review of Entomology. Insect nutrition, nutritional factors in insect resistance to chemicals, the biochemistry of insect hemolymph, the role of mitochondria in respiratory metabolism of flight muscle, diurnal rhythms, the theoretical and practical study of natural insect populations and other problems are discussed. ***Edward A. Steinhaus and Ray F. Smith, editors.*** v. VI. 470 pp. 1961. Annual Reviews, Inc., Palo Alto, Calif. (QL461 An78 Vis.)

* **Sugar-Cane Wax. III. Composition of Solvent-Refined Wax From Sugar-Cane Mud. *J. A. Lamberton and A. H. Redcliffe.*** *Australian Journal of Applied Science,* v. 2, no. 4, Dec. 1960, p. 473-480.

BIOCHEMISTRY AND BIOPHYSICS

Prophage Substitution and Curing in Lysogenic Cells Superinfected With Hetero-Immune Phage. Prophage substitution occurs perferentially in location I. Besides "total curing," involving all prophages, there is also "partial curing," involving only one prophage of doubly lysogenic cells. ***Erich Six.*** *Journal of Bacteriology,* v. 80, no. 5, Nov. 1960, p. 728-729.

* **Variability in the Structure of Ribonucleic Acid.** A profound structural alteration in the RNA ribonucleic acid accumulated during methionine starvation is of particular interest

in view of the uniquely retarded resumption of protein synthesis in these organisms after the restoration of methionine. It may be pertinent that the methylated bases are normally present in the "soluble" RNA which is strongly implicated in protein synthesis. ***Lewis R. Mandel and Ernest Borek.*** *Biochemical and Biophysical Research Communications,* v. 4, no. 1, Jan. 1961, p. 14-18.

* **The Effect of Total X-Radiation on the Content of Sulfhydryl Groups in the Tissues.** (*In Russian.*) Vliianie obshchego rentgenovskogo oblucheniia na soderzhanie tkanevykh sul'fgidril'nykh grupp. ***L. I. Korchak and T. A. Speranskaia.*** *Akademiia Nauk SSSR, Doklady,* v. 135, no. 5, Dec. 1960, p. 1254-1257.

* **Changes in Vital Staining of Tissues After Total Irradiation of the Animals by X-Rays.** The doses administered were from 25 to 700 r. A direct relation between the amount of dye bound by the tissue and the irradiation dose was found. There is a phase character of the change in the vital staining of the tissues in time. (*In Russian.*) Izmeneniia prizhiznennoĭ okrashivaemosti tkaneĭ pri total'nom obluchenii zhivotnykh luchami rentgena. ***V. I. Skorik and S. N. Romanov.*** *TSitologiia,* v. 2, no. 6, Nov.-Dec. 1960, p. 710-716.

* **Preliminary Data on the Cultivation of Tularemia, Brucellosis and Plague Agents on a Medium With a Natural Enzyme Hydrolysate-Aminopeptide-2. I. (Author's Summary).** (*In Russian.*) Predvaritel'nye dannye po kul'tivirovaniiu vozbuditeleĭ tuliaremii, brutselleza i chumy na srede s otechestvennym fermentativnym gidrolizatom aminopeptidom-2. I. (Avtoreferat). ***A. C. Leibenzon and Z. F. Luchsheva.*** *Zhurnal Mikrobiologi, Epidemiologii, i Immunobiologii,* v. 31, no. 12, Dec. 1960, p. 102-103.

* **Aerosol Immunization With Dry Living Vaccines and Toxoids. IV. The Character and Dynamics of Vaccine Process in Aerosol Immunization With Dust Vaccines: Brucellosis, Tularemia, Anthrax and Plague.** In small laboratory animals the vaccine process following aerosol immunization is characterized by the penetration of the microbes into the body through the conjunctiva, upper respiratory tract, bronchi, lungs and the gastrointestinal tract with the involvement of numerous regional lymph nodes, thus creating favorable conditions for the immunological readaptation of organism. (*In Russian.*) Aerozol'naia immunizatsiia sukhimi zhivymi vaktsinami i anatoksinami. IV. Kharakter i dinamika vaktsinnogo protsessa pri aerozol'noĭ immunizatsii brutselleznoĭ, tuliaremiĭnoĭ, sibireiazvennoĭ i protivochumnoĭ pylevymi vaktsinami. ***N. I. Aleksandrov, N. E. Gefen, K. G. Gapochka, and N. S. Garin.*** *Zhurnal Mikrobiologii, Epidemiologii, i Immunobiologii,* v. 31, no. 12, Dec. 1960, p. 38-44.

* **Therapeutic Action of Gallic Acid Derivatives in Acute Radiation Sickness.** Sodium gallate and propyl gallate caused survival of up to 50% of mice irradiated with a lethal dose of 600 r. The preparations are effective in preventive administration and in large doses immediately after irradiation. The application of gallates at a longer interval after irradiation (one hour later) is considerably less effective. (*In Ukrainian.*) Likuval'na diia pokhidnykh galovoyi kysloty pry gostriyi promeneviyi khvorobi. ***O. A. Gorodetskiĭ, V. A. Baraboĭ, and V. P. Chernets'kiĭ.*** *Akademiia Nauk Urkraïns'koï RSR, Dopovidi,* 1960, no. 12, p. 1635-1637.

Genetic Studies on Amethopterin Resistance in *Diplococcus pneumoniae.* A series of amethopterin-resistant mutants of *Diplococcus pneumoniae,* were genetically analyzed by deoxyribonucleic acid-mediated transformation techniques. Six distinct genotypes were identified; three contained only a single genetic marker inducing resistance to amethopterin, whereas the other three contained two markers in the genome. ***Francis M. Sirotnak, Ramona B. Lunt, and Dorris J. Hutchison.*** *Journal of Bacteriology,* v. 80, no. 5, Nov. 1960, p. 648-653.

* **Virus-Induced Abnormalities of Mitosis in Certain Solanaceous Species.** Mitotic abnormalities were observed in a range of solanaceous species infected respectively with tobacco mosaic virus and aspermy virus. These abnormalities ranged from persistance of the nucleolar material as far as early anaphase, in all cases observed, to a complete amitosis. ***J. Wilkinson.*** *Annals of Botany,* v. 24, no. 96, Oct. 1960, p. 516-521.

* **Genetic Effects of Chronic X-Irradiation Exposure in Mice.** Genetic damage to the immediate off-spring of the irradiated mice was detected in the forms of increased juvenile mortality, increased occurrence of rare morphological abnormalities, and progeny-tested mutations affecting both morphology and fecundity. ***Donald R. Charles, Joseph A. Tihen, Eileen M. Otis, and Arnold B. Grobman.*** *Genetics*, v. 46, no. 1, Jan. 1961, p. 5-8.

* **The Viscosity of Thymus Deoxyribonucleic Acid in Rats Subjected to X-Radiations.** With *in vivo* radiation a degradation of DNA occurs, but unlike in the *in vitro* radiation there is a marked latent time until the viscosity begins to decrease. The latent time is three hours after an 800 r total radiation. After four hours, the values of controls become significantly different. The latent time is longer still after lower doses. (*In German.*) Viskosität der Thymus-Desoxyribonukleinsäure in röntgenbestrahlten Ratten. ***Ulrich Hagen.*** *Naturwissenschaften*, v. 47, no. 24, Dec. 1960, p. 601.

* **Comparative Testing of Tobacco Smoke Condensates, Benzopyrene and Tobacco Extract on the Carcinogen Effects in Rats.** According to this survey of investigations since 1954, the assumption that carcinogen substances in tobacco tar are formed during smoking becomes doubtful. Results of research would rather indicate that the carcinogen substances can exist in tobacco before smoking, so that this process should also be considered from the point of view of decontamination, and not only of poisoning. (*In German.*) Vergleichende Prüfung von Tabakrauch-Kondensaten, Benzpyren und Tabak-Extrakt auf carcinogene Wirkung an Ratten. ***H. Druckrey, D. Schmähl, H. Beuthner, and F. Muth.*** *Naturwissenschaften*, v. 47, no. 24, Dec. 1960, p. 605-606.

* **Max-Planck Institute for Biology [Tübingen, Germany].** This is one of a series of reports concerning the activities of the Max-Planck Society over a recent two-year period. Among the many investigations mentioned, some were concerned with the importance of "puffs" and Balbiani rings in the giant chromosomes of *Chironomus* and other diptera, the physiology and growth of the salivary glands of *Chironomus*, the importance of the sex chromosomes of *Drosophila melanogaster*, and problems concerning the synthesis of virus RNA in cell nuclei of tissue cultures. (*In German.*) Max-Planck-Institut fur Biologie. *Naturwissenschaften*, v. 47, no. 24, Dec. 1960, p. 559-562.

* **The Analysis of Mitoses in Single Living Cells by Interference Microscopy.** The method has been applied to the analysis of changes of dry mass in the chromosomes, spindle and cell-plate area during mitosis in endosperm. Shows that birefringence develops under conditions of progressively increasing concentration of macro-molecular material. ***E. J. Ambrose and A. Bajer.*** *Royal Society, Proceedings*, v. 153, ser. B, Jan. 3, 1961, p. 357-366 + 1 plate.

Immunological Tolerance. "Immunological tolerance" may be described as a state of indifference or nonreactivity towards a substance that would normally be expected to excite an immunological response. Some properties of the tolerant state, tolerance and runt disease, other forms of immunological nonreactivity, biological significance, and theories of tolerance are discussed. ***P. B. Medawar.*** *Nature*, v. 189, Jan. 7, 1961, p. 14-17.

* **The Relationship Between the Structure and Protective Action of Thiol and Other Sulfur-Containing Compounds in Radiation Injury.** (*In Russian.*) O zavisimosti mezhdu strukturoĭ i zashchitnym deĭstviem tiolovykh i drugikh serusoderzhashchikh soedineniĭ pri luchevom porazhenii. ***G. A. Belonozhko and V. E. Petrun'ko.*** *Meditsinskaia Radiologiia*, v. 5, no. 11, Nov.1960, p. 87.

* **On the Behavior of S^{35} Cystamine in the Animal Organism.** (*In Russian.*) K voprosu o povedenii S^{35} tsistamina v organizme zhivotnykh. ***A. V. Titov.*** *Meditsinskaia Radiologiia*, v. 5, no. 11, Nov. 1960, p. 87-88.

* **The Effect of Ionizing Radiation on the Cytochromoxidase Activity of Certain Tissues of the Animal Organism in Total Irradiation.** (*In Russian.*) Deĭstvie ioniziriushchego izlucheniia na tsitokhromoksidazmuiu aktivnost' nekotorykh tkaneĭ zhivotnogo organizma pri obshchem ego obluchenii. ***L. V. Mytareva.*** *Meditsinskaia Radiologiia*, v. 5, no. 11, Nov. 1960, p. 88.

a * **A Device for Roentgenography of Each Tooth Separately.** (*In Russian.*) Prisposoblenie dlia polucheniia razdel'nogo rentgenovskogo izobrazheniia zubov. ***A. A. Kritskii.*** *Vestnik Rentgenologii i Radiologii*, v. 35, no. 6, Nov.-Dec. 1960, p. 70.

b * **The Mitotic and Radioprotective Effect of Cysteine and Lysine in Rat.** A survey of the literature is given, material and methods, mitotic effects of cysteine and lysine, and the radioprotective effect of cysteine and lysine are discussed. ***Lars R. Holsti.*** *Acta Radiologica* (Supplementum 197), 1960, 99 pp.

c * **Radiation Disease and Autolysis.** A review of literature data with an attempt to explain them in the light of modern theories about the biological action of ionizing radiations. Discusses the autolysis of tissues in vitro and in vivo, the comparative identification of the changes observed in diseases and autolysis, the mechanism of development of an autolytically similar process during radiation diseases. (*In Russian.*) Luchevoe porazhenie i avtoliz. ***V. N. Benevolenskii.*** *Uspekhi Sovremennoĭ Biologii*, v. 50, no. 3(6), Nov.-Dec. 1960, p. 310-321.

d * **Mutation, Cancer, and Ageing.** Mutation, cancer, and aging are attributed basically to the side-effects of endogenously formed free radicals. Experimental work on aging based on this hypothesis has been encouraging; several antioxidants were found to increase the half-survival time of AKR and C3H mice. The prolongation with 2-mercaptoethylamine was about 20%. Serum-mercaptan levels, as predicted by the free-radical hypothesis, were found to decrease with age. ***Denham Harman.*** *Lancet*, no. 7170, Jan. 28, 1961, p. 200-201.

e * **Thiazolidines and Aminoalkylthiosulfuric Acids as Protecting Agents Against Ionizing Radiation.** Activity may be due to decomposition of the compounds into the corresponding mercaptoamines. ***A. Kaluszyner, P. Czerniak, and Ernst D. Bergmann.*** *Radiation Research*, v. 14, no. 1, Jan. 1961, p. 23-27.

f * **X-Irradiation of the Giant Amoeba, *Pelomyxa illinoisensis*. III. Electron Microscopy of Centrifuged Organisms.** Mitochondria appear to be the essential components of donor cytoplasm required for recovery and mass culture formation in supralethally irradiated organisms. ***E. W. Daniels and L. E. Roth.*** *Radiation Research*, v. 14, no. 1, Jan. 1961, p. 66-82.

Limitations on Space Flight Due to Cosmic Radiations. ***Howard J. Curtis.*** *Science*, v. 133, Feb. 3, 1961, p. 312-316.

g **Immunological Recognition of Self.** ***F. M. Burnet.*** *Science*, v. 133, Feb. 3, 1961, p. 307-311.

Immunological Tolerance. ***Peter Brian Medawar.*** *Science*, v. 133, Feb. 3, 1961, p. 303-306.

h * **Some New Keys to Cosmetic Chemistry—1960.** A highly condensed review of important literature of 1960 relating to cosmetic chemistry. Lists 395 references. ***Paul G. I. Lauffer.*** *Toilet Goods Association, Proceedings of the Scientific Section*, no. 34, Dec. 1960, p. 19-38.

i * **Odor-Intensity and the Stereochemical Theory of Olfaction.** ***James W. Johnston, Jr. and Albert B. Parks.*** *Toilet Goods Association, Proceedings of the Scientific Section*, no. 34, Dec. 1960, p. 4-7.

j * **Failure of Immunization Against Tumorigenesis.** Of 421 mice immunized, 267, or 63% became tumorous as a result of exposure to carcinogen. In a comparable period, 237, or 65% of 375 unimmunized control mice developed tumors. ***Richmond T. Prehn.*** *U. S. National Cancer Institute, Journal*, v. 26, no. 1, Jan. 1961, p. 223-227.

* **The Perception of Light and Colour and the Physiology of Vision.** Papers on the mechanism of perception; the visual pigments; the carotenoid pigment; ferroheme and ferriheme; the color triangle; defective color vision; and a general summary. ***C. V. Raman.*** *Indian Academy of Sciences, Proceedings*, v. 52, secs. A and B, no. 6, Dec. 1960, 74 pp.

k **Theories of Shape Discrimination in *Octopus*.** ***J. A. Deutsch and N. S. Sutherland.*** *Nature*, v. 188, Dec. 24, 1960, p. 1090-1094.

Sun Navigation by Birds. ***R. J. Pumphrey.*** *Nature*, v. 188, Dec. 24, 1960, p. 1127.

* **Base Pairing in DNA.** Five new geometrically acceptable H-bonded base pairs which might be formed by the bases in nucleosides have been suggested. The dimensions of one of these new pairs, adenine-guanine, are such that this pair would apparently fit in the Watson-Crick DNA helix. ***Jerry Donohue and Kenneth N. Trueblood.*** *Journal of Molecular Biology*, v. 2, no. 6, Dec. 1960, p. 363-371.

* **On Macromolecular Structure of Native High-Polymer Ribonucleic Acid in Solution.** Some new data are reviewed, and the configurations of high-polymer RNA in solution, under different conditions, are discussed on the basis of available data on viscosity, sedimentation, light-scattering, optical rotation, u.v. absorption and electric dichroism measurements. ***A. S. Spirin.*** *Journal of Molecular Biology*, v. 2, no. 6, Dec. 1960, p. 436-446.

* **Gene Unstabilization Induced by Heat and by Nitrous Acid.** The treatment by heat (130 to 155 C) or by nitrous acid induces, in addition to stable mutants, unstable lactose fermentation mutants (*E. coli*) and unstable auxotrophs (*E. coli* and *B. subtilis*). ***Stephen Zamenhof.*** *Journal of Bacteriology*, v. 81, no. 1, Jan. 1961, p. 111-117.

Genetic Analysis, by Means of Transformation, of Histidine Linkage Groups in *Bacillus subtilis*. Two distinct linkage groups were identified. One group was found to be closely linked to the indole marker. Preliminary studies of the corresponding biochemical reactions in the histidine biosynthetic pathway suggest that one linkage group is concerned with the block at the region responsible for the formation of imidazole glycerol phosphate and the second one with the block at the region responsible for the reactions leading from histidinol to histidine. ***Erela Ephrati-Elizur, P. R. Srinivasan, and Stephen Zamenhof.*** *National Academy of Sciences, Proceedings*, v. 47, Jan. 1961, p. 56-63.

* **On the Configuration of Molecules of Infectious Viral Ribonucleic Acid in Solution, According to Data of Electric Dichroism Measurements.** In the case of a compact contorted RNA configuration, at room temperature, the bases in the molecules are preferably in a parallel arrangement to the long axis of the molecule. In the case of a developed configuration, at an elevated temperature, the bases are oriented preferably perpendicularly to the long axis of the molecule. (*In Russian.*) O konfiguratsii molekul infektsionnoĭ virusnoĭ ribonukleinovoĭ kisloty v rastvore po dannym izmereniia elektricheskogo dikhroizma. ***G. A. Dvorkin and A. S. Spirin.*** *Akademiia Nauk SSSR, Doklady*, v. 135, no. 4, Dec. 1960, p. 987-990.

Linkage of Genetic Units of *Bacillus subtilis* in DNA Transformation. ***Eugene W. Nester and Joshua Lederberg.*** *National Academy of Sciences, Proceedings*, v. 47, Jan. 1961, p. 52-55.

* **Formation of a DNA-Containing Virus by Host RNA.** (*In Ukrainian.*) Utvorennia za dopomogoiu RNK khaziayina virusu shcho mistyt' DNK. ***S. M. Gershenzon, I. P. Kok, K. Yi. Vitas, H. M. Dobrovol'skaya, and I. N. Skuratovs'kaya.*** *Akademiia Nauk Ukrains'koĭ RSR, Dopovidi*, 1960, no. 12, p. 1638-1641.

CERAMICS AND CONCRETE

* **A New Corrosion Resistant Concrete. Its Use for the Construction of Pipes and Sewers.** The "Ocrate" process consists of treating the concrete, previously dried, by gaseous SiF_4. After this treatment, the concrete shows an increased resistance to corrosion by salts and acids and can be used in the construction of pipes for industrial waste waters and town sewage. (*In French.*) Nouveau béton résistant à la corrosion. Son emploi pour la construction de canalisations et d'égouts. ***G. Roederer.*** *Chimie & Industrie*, v. 84, no. 6, Dec. 1960, p. 912-922.

* **Movements in Concrete During the Period Following Its Compaction in a Mould.** Movements may account for appreciable variations in the pore structure of hardened concrete near horizontal surfaces. ***J. D. McIntosh.*** *R.I.L.E.M. International Association of Testing and Research Laboratories for Materials and Structures, Bulletin No.* 9, Dec. 1960, p. 6-10.

* **Shrinkage and Creep of Concrete.** Both are directly proportional to the amount of cement paste in the concrete. Creep is directly proportional to the sustained stress. Both are greatly affected by the relative humidity of the atmosphere. (*In French.*) Fluage et retrait du béton. ***I. Lyse.*** *R.I.L.E.M. International Association of Testing and Research Laboratories for Materials and Structures, Bulletin No.* 9, Dec. 1960, p. 93-99.

* **Crack Formation Due to Shrinkage of Reinforced Concrete.** A theoretical study of deformation in the course of drying of a prism. ***Sven T. A. Odman.*** *R.I.L.E.M. International Association of Testing and Research Laboratories for Materials and Structures, Bulletin No.* 9, Dec. 1960, p. 100-109.

* **The Development of Microcracks in Concrete.** Presents evidence which shows that microcracks occur in concrete specimens prior to failure. Considers influence of cracks on the ultimate failure of the concrete. ***R. Jones.*** *R.I.L.E.M. International Association of Testing and Research Laboratories for Materials and Structures, Bulletin No.* 9, Dec. 1960, p. 110-114.

The Thermodynamics of the Changes Undergone by Kaolinite When Heated. Considers the thermodynamic probability of the formation of sillimanite and mullite. ***P. P. Budnikov and O. P. Mchedlov-Petrosyan.*** *British Ceramic Society, Transactions*, v. 59, Nov. 1960, p. 479-482.

* **Rheological Behavior of Hardened Cement Paste Under Low Stresses.** Deformational response of the material to load is dependent on hygrometric conditions to such a degree as to make the resulting quantitative differences seem like differences of quality. ***Joseph Glucklich and Ori Ishai.*** *American Concrete Institute, Journal*, v. 32, *ACI Proceedings*, v. 57, no. 8, Feb. 1961, p. 947-964.

* **The Alkalis in the Structure of Portland Clinker.** For better elimination of alkalis during clinkering, the raw material must be granulated as finely as possible, within the limits of the technical properties to be maintained. The alkalis will remain in the vitreous phase and will not form $KC_{23}S_{12}$ and NC_8A_3 compounds by crystallization during slow cooling if the clinker is cooled as rapidly as possible. (*In Spanish.*) Los álcalis en la estructura del "clinker" de cemento de Portland. ***J. Calleja.*** *Revista de Ciencia Applicada*, v. 14, no. 76, Sept.-Oct. 1960, p. 397-411.

Ceramic Colors Symposium. Reviews ceramic stains from zirconium and vanadium oxides, use of cobalt colors in glazes, chrome-alumina pink at various temperatures, ceramic green colors for whiteware glazes, chrome-tin pinks and maroons, tin-vanadium yellows and praseodymium yellows, gray and black stains in whiteware glazes, and plant control problems with whiteware glazes containing brown and tan stains. ***C. A. Seabright, et al.*** *American Ceramic Society Bulletin*, v. 40, Jan. 15, 1961, p. 1-24.

Bond Structure and the Behaviour of Basic Bricks at High Temperatures. Attempts were made to develop a direct bond between chrome and magnesia grains in a basic brick. ***H. M. Richardson, K. Fitchett, and M. Lester.*** *British Ceramic Society, Transactions*, v. 59, Nov. 1960, p. 483-504.

Sintering of Oxide and Carbide-Metal Compositions in Presence of a Liquid Phase. Dependence of the sintering rate on time, particle size, and temperature. ***W. D. Kingery, E. Niki, and M. D. Narasimhan.*** *American Ceramic Society, Journal*, v. 44, Jan. 1961, p. 29-35.

The System Ca_2SiO_4-Mn_2SiO_4. Results of quenching experiments on mixtures lying along the Ca_2SiO_4-Mn_2SiO_4 join of the CaO-MnO-SiO_2 system are presented. The O partial pressure was controlled to maintain Mn as Mn^{2+}. ***F. P. Glasser.*** *American Journal of Science*, v. 259, no. 1, Jan. 1961, p. 46-59.

* **Mineralogy and Utilization of British Clays.** ***P. S. Keeling.*** *Claycraft*, v. 34, no. 3, Dec. 1960, p. 76 + 4 pages.

Stability Relations of Calcium Ferrites: Phase Equilibria in the System $2CaO \cdot Fe_2O_3$-$FeO \cdot Fe_2O_3$-Fe_2O_3 Above 1135°C. Desired total compositions of samples were attained by weighing

starting materials in required proportions and keeping them in sealed 80% Pt-20% Rh tubes during equilibration runs. The liquidus surface was delineated, the existence of two ternary compounds established, and seven ternary invariant situations determined. ***Bert Phillips and Arnulf Muan.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 6, Dec. 1960, p. 1112-1118.

Stability of Refractories in Hydrogen-Fluorine Flames. Flame resistance was measured in the well-mixed stoichiometric portion and in the unmixed fluorine-rich portion of diffusion flame. ***M. Ebner.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 7-12.

Studies of Reactions Between Uranium Dioxide and Graphite. Heated together in an inert atmosphere at temperatures up to 2130 C, reaction rates were found to follow a parabolic rate equation. ***B. Craven and Eric R. McCartney.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 12-15.

Colors and Magnetic Properties of Iron in Glasses of Various Types and Their Implications Concerning Structure. II. Cabal Glasses. ***Adli Bishay.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 16-21.

Fracture Velocity and Fracture Energy of Glass in the Fatigue Range. Concludes that surface energy must constitute only a small part of the energy absorbed in the fracture process. This excess energy has a pronounced influence on the fracture process and on the measured strength of glass. ***Errol B. Shand.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 21-26.

Transformation of Quartz to Cristobalite. Studies in the temperature range 1400 to 1650 C. The process, which was believed to be a direct one, was found to be a consecutive reaction involving an intermediate transition phase. ***A. C. D. Chaklader and A. L. Roberts.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 35-41.

High-Temperature Reactions of Clay Mineral Mixtures and Their Ceramic Properties. III. Shrinkage and Porosity in Relation to Initial Mineralogy. Conclusions are drawn regarding the influence of mineralogical composition on the ceramic properties. ***G. W. Brindley, Dorothy M. Marsh[illegible]ey, and S. Udagawa.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 42-47.

Thermal Conductivity of UO_2 to 2100°C. Radial heat flow method was used for measurement. ***R. D. Reiswig.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 48-49.

Phase Equilibria in the System Cadmium Oxide—Niobium Oxide. Studied by using quenching methods and sealed Pt tubes. ***R. S. Roth.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 49-50.

* **Some Physical Aspects of the Hydration of Portland Cement.** The hydration process occurs without much dilation of the specimen. An explanation is given, showing how the chemical processes are controlled by physical conditions peculiar to a system giving a gel as reaction product. ***T. C. Powers.*** *Portland Cement Association, Journal of the Research and Development Laboratories,* v. 3, no. 1, Jan. 1961, p. 47-56.

* **A Rapid Method for the Analysis of Ceramic Raw Materials and Finished Products.** SiO_2 is determined gravimetrically by the HCl-gelatin method, TiO_2 and Fe_2O_3 is determined colorimetrically, Al_2O_3, CaO, and MgO complexometrically and the alkalis by flame photometry. (*In German.*) Eine schnellmethode zur Analyse keramischer Rohstoffe und Fertigerzeugnisse. ***Otto Staufenberger.*** *Sprechsaal,* v. 94, no. 1, Jan. 5, 1961, p. 9-11.

CHEMICAL ENGINEERING

* **Energy Losses in a Vertically Moving Compressible Emulsion.** Examines the losses in a compressing column containing an air and water emulsion. This leads to the theoretical investigation of coalescence, which accounts for instability in uniform emulsions. The experimental results obtained on two

installations much different from one another corroborate the theoretical predicted data regarding losses due to slipping and other important parameters. (*In French.*) Pertes d'énergie dans une émulsion compressible en mouvement vertical. ***Jacques Bonnin.*** *Chimie & Industrie (Génie Chimique),* v. 84, no. 6, Dec. 1960, p. 210-216.

* **The Efficiency of Continuous Rotary Drum Filtration.** A new approach for analysis of continuous filtration is presented based on examination of relative pressure drop across the filter medium and across the cake. Treatment of data indicates the optimum filter media, or most efficient filtration, to obtain a separation in cake filtration. ***Harrison R. Cooper.*** *British Chemical Engineering,* v. 6, Jan. 1961, p. 35-39.

* **The Cooling and Dehumidification of Manufactured Gas.** A design method is developed which, in conjunction with tabulated values of properties of the town-gas water vapor system, can be applied in reverse, without trial and error procedures, to obtain coefficients from performance data for cooler-condensers employed by the gas industry. The formation of fog in such a plant is discussed quantitatively. ***G. S. Cribb.*** *British Chemical Engineering,* v. 6, Jan. 1961, p. 26-34.

Pfaudler-Permutit Plans Hot Waste Treater. Ion exchange-evaporation combination passes pilot-plant tests, goes to prototype stage. *Chemical and Engineering News,* v. 39, no. 2, Jan. 9, 1961, p. 46-47.

* **Similarity in Chemical Reactions.** The so-called reactors used to carry out the processes may work on continuous or intermittent operation, in uniform or nonuniform phase. Reviews the various methods for designing homogeneous reactors and shows how, in the absence of these data, the reactor may still be scaled-up. Changing from discontinuous to continuous operation is always possible by using a tubular reactor in turbulent flow conditions. (*In French.*) Similitude dans les réactions chimiques. ***P. Trambouze.*** *Chimie & Industrie (Génie Chimique),* v. 84, no. 6, Dec. 1960, p. 189-209.

* **Resistance Laws for Internally-Sprayed, Vertical Tubes Through Which Gas Flows.** From the theoretical relationships of the resistance law, simple and easily manipulated laws are developed for the ranges of flow which occur. Interesting special cases are dealt with. (*In German.*) Widerstandsgesetze für innen berieselte und gasdurchströmte senkrechte Rohre. ***H. Brauer.*** *Chemie-Ingenieur-Technik,* v. 32, Nov. 1960, p. 719-725.

* **The Immedium Filter—A New Filter Technique.** Operation of the filter is essentially with an upward flow and the filtrate is removed by a drainage system embedded in the upper very fine filter layer. Advantages are cited. (*In German.*) Das Immedium-Filter—eine neuartige Filtertechnik. ***K. Heinrich.*** *Chemie-Ingenieur-Technik,* v. 32, Nov. 1960, p. 734-739.

* **Studies on the Selective Hydrogenation of Fats and Oils. V. Selective Docosenic Acids Formed by the Hydrogenation of Methyl Clupanodonate. VI. Hydrogenation of Mixtures of Free Fatty Acids and Esters. VII. Hydrogenation of Soybean Oil With Iron Pentacarbonyl Catalyst.** (*In Japanese.*) V-VII. ***Tomotaro Tsuchiya and Tetsutaro Hashimoto.*** VII ***Tetsutaro Hashimoto and Hisako Shiina.*** *Government Chemical Industrial Research Institute, Tokyo, Reports,* v. 55, Dec. 1960, p. 477-489.

* **Recovery Methods for Acetic Acid.** In some processes great quantities were lost as vapors or waste, because separation methods were too expensive. Progress has led to economical methods which are interesting for other separations. Describes processes used: azeotropic distillation, extractive distillation, liquid-liquid extraction. (*In French.*) Les méthodes de récupération de l'acide acétique. ***D. F. Othmer.*** *Chimie & Industrie,* v. 84, no. 6, Dec. 1960, p. 896-907.

* **Computers. II. Applications in Chemical Processing.** The process industries will use more computers for eliminating pilot plants, designing equipment, estimating costs, maximizing profits, and controlling automatic plants. ***Alexis W. Lemmon, Jr. and Benjamin B. Gordon.*** *Industrial Research,* v. 2, no. 6, Dec. 1960-Jan. 1961, p. 20-25.

Centrifugal Phase-Barrier Recompression Distillation. A laboratory still at Columbus, Ohio, has been used for basic studies of the parameters that influence the evaporating and

condensing heat transfer coefficients of a rotating surface. The estimated cost of distilling 50,000 to 100,000 gallons per day with the Hickman process is between $1.75 and $1.20 per 1000 gallons, depending mainly on the useful life assigned to the evaporator. ***K. C. D. Hickman, W. J. Hogan, J. A. Eibling, and W. L. Buckel.*** Paper from "Saline Water Conversion. Advances in Chemistry Series", no. 27, p. 128-146, 1960. American Chemical Society, Washington, D. C. (TD433 Sy68s)

Water Purification by Zone-Freezing. The economics of purification of saline water by zone-freezing were investigated using analog simulation as a tool to optimize the design. Estimated costs for the process were found to be too high to make it competitive with other processes now under development. ***William H. Mink, George F. Sachsel, and R. B. Filbert, Jr.*** Paper from "Saline Water Conversion. Advances in Chemistry Series", no. 27, p. 75-81, 1960. American Chemical Society, Washington, D. C. (TD433 Sy68s)

Saline Water Conversion. Advances in Chemistry Series. A collection of 22 papers comprising the Symposium on Saline Water Conversion, presented before the Division of Water and Waste Chemistry at the 137th National Meeting of the American Chemical Society, Cleveland, Ohio, Apr. 1960. No. 27. 246 pp. 1960. American Chemical Society, Washington, D. C. (TD433 Sy68s)

Field Evaluation of Solar Sea Water Stills. Construction methods and performance data are presented on solar sea water stills under evaluation at the Florida Solar Distillation Research Station. Three stills representing two basic designs have been constructed and operated there: a 2500-sq.-ft. glass-covered deep-basin still and 2300- and 500-sq.-ft., air-supported plastic stills. ***J. W. Bloemer, R. A. Collins, and J. A. Eibling.*** Paper from "Saline Water Conversion. Advances in Chemistry Series", no. 27, p. 166-177, 1960. American Chemical Society, Washington, D. C. (TD433 Sy68s)

A Theorem of "Dynamic Conservation" for Dist... Under certain conditions, for a distillation column with ...oretical plates operating with a binary mixture, a quantity which represents the amount of "disturbance" in the column can be defined. Changes of the operating conditions inject "disturbance" into the column, where it subsequently decays under the action of the column itself. The result holds for any equilibrium relationship between vapor and liquid compositions. ***H. H. Rosenbrock.*** *Institution of Chemical Engineers, Transactions,* v. 38, no. 6, 1960, p. 279-287.

On the Continuous Preparation of Vinyl Grignard Reagents. Laboratory apparatus is described. ***Herbert K. Reimschuessel.*** *Journal of Organic Chemistry,* v. 25, Dec. 19..., p. 2256-2257.

Making New Materials at Very High Pressures. Po...lities of creating a wide range of substances, including s...conductors, harder steels, and a new family of plastics ***... A. Gebbie.*** *New Scientist,* v. 8, Dec. 22, 1960, p. 1660-16...

* **Direct Production of Acetone From the Gas Product of the Partial Oxidation of Methane. III. Operation of the Three-Plate Adiabatic Plant Reactor Under Stationary Conditions. IV. Operation of the Three-Plate Adiabatic Plant Under Non-Stationary Conditions.** (*In German.*) Direkte herstellung von aceton aus dem produktgas der partiellen oxydation des methans. III. Arbeitsweise des dreibödigen adiabatischen betriebsreaktors unter stationären bedingungen. IV. Arbeitsweise des dreibödigen adiabatischen betriebsreaktors unter nicht stationären bedingungen. ***G. Almásy and I. Pallai.*** *Acta Chimica Academiae Scientiarum Hungaricae,* v. 24, no. 4, 1960, p. 385-409.

* **The Effect of Take-Off Velocity on the Efficiency of Film Rectifying Columns.** The operating part of the column was a pipe with an inserted rod, the distance between them being 0.075 cm. The HETP of the columns was ~ 1cm. Benzene–dichloroethane and n-heptane–methylcyclohexane mixtures were distilled. The results obtained are well described by an equation proposed earlier. The equations of Westhaver and of Peshkov agree with the experimental data only for small take-off rates. (*In Russian.*) Vliianie shorosti otbora distillata na pazdelitel'nu sposobnost' plenochnykh pektifikatsionnykh kolonn. ***G. G. Devyatykh and N. Kh. Agliulov.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 11, Nov. 1960, p. 2509-2512.

The Importance of Surfaces in Chemical Engineering. Some properties of surfaces and how a number of the unit operations of chemical engineering are dependent on surface phenomena. ***J. T. Davies.*** *Institution of Chemical Engineers, Transactions,* v. 38, no. 6, 1960, p. 289-293.

The Effect of Surface Tension Changes on the Minimum Wetting Rates in a Wetted-Rod Distillation Column. The minimum wetting rates were measured for the distillation of mixtures of methanol or *n*-propanol with water in a wetted-rod column. The values were found to depend on the liquid surface tension, σ, and on the change in surface tension, $\Delta\sigma$, due to mass transfer from the vapor to the liquid. ***W. S. Norman and D. T. Binns.*** *Institution of Chemical Engineers, Transactions,* v. 38, no. 6, 1960, p. 294-300.

Surface Effects in a Rotating-Disk Contactor. Two possible mechanisms for the high efficiency of rotating-disk contactors in liquid-liquid extraction have been studied. The first involves repeated break-up of the droplets of dispersed phase with exposure of fresh interface followed by coalescence and further break-up. The second involves very effiicent stirring round the surface of each discrete drop of dispersed phase. Finds that the second mechanism is operative, and further, that the efficiency of extraction of phenol from water to kerosene can be made considerably more efficient by surface-active agents. ***J. T. Davies, I. M. Ritchie, and D. C. Southward.*** *Institution of Chemical Engineers, Transactions,* v. 38, no. 6, 1960, p. 331-334.

* **Adsorptive Precipitation and Skimming of Detergents From Aqueous Solutions.** (*In German.*) Über die adsorptive Fällung und die Verschäumung von Detergentien aus wässrigen Lösungen. ***H. P. Kaufmann and F. Malz.*** *Fette, Seifen, Anstrichmittel,* v. 62, no. 11, Nov. 1960, p. 1024-1030.

* **Changes in Monoglyceride Content and Fatty Acid Composition With Different Ways of Fat Splitting.** Concludes that during splitting, hydrolysis as well as esterification between glycerin and the neutral part occurs which results in an equilibrium of the latter, depending on the conditions of splitting. (*In German.*) Änderungen des Monoglycerid-Gehaltes und der Fettsäure-Zusammensetzung während der auf verschiedene Weise durchgeführten Fettspaltungen. ***J. Perédi.*** *Fette, Seifen, Anstrichmittel,* v. 62, no. 11, Nov. 1960, p. 1034-1041.

* **Direct Production of Acetone From the Gas Product of Partial Oxidation of Methane. V. Fouling and Regeneration of the Catalyst Under Plant Conditions.** The way for operating the reactor with a catalyst of decreasing activity is presented and a method is suggested for the calculation of the optimum period of regeneration. (*In German.*) Direkte herstellung von aceton aus dem produktgas der partiellen oxydation des methans. V. Ermüdung und regenerierung des katalysators unter betriebsverhältnissen. ***I. Pallai and G. Almásy.*** *Acta Chimica Academiae Scientiarum Hungaricae,* v. 25, no. 1, 1960, p. 33-47.

Nonequilibrium Thermodynamic Theory for Concentration Profiles in Liquid Extraction. Profiles have been computed for an idealized extraction process, and have been found to depart from the equilibrium curve. ***Alphonse Hennico and Theodore Vermeulen.*** *U. S. Atomic Energy Commission, UCRL-9415,* Sept. 30, 1960, 56 pp. (UF767 U3u Contin.)

A Guide to Continuous Filtration of Precipitates. ***R. C. Emmett and D. A. Dahlstrom.*** *Mining Engineering,* v. 13, Jan. 1961, p. 46-50.

Saline Water Conversion by Multiple-Effect Rotating Evaporator. Preliminary tests prove validity of performance predictions. ***Richard L. Clark and LeRoy A. Bromley.*** *Chemical Engineering Progress,* v. 57, Jan. 1961, p. 64-70.

Stop Scale in Sea Water Evaporators. Either acid injection or seeding shows great promise for scale prevention in saline water converters. ***F. C. Standiford and J. R. Sinek.*** *Chemical Engineering Progress,* v. 57, Jan. 1961, p. 58-63.

* **Five Criteria for Keeping Centrifugal Pumps in Service.** ***E. D. Schwandt and John W. Felton.*** *Paper Trade Journal,* v. 145, Jan. 30, 1961, p. 24-28.

Discrepancies Between Design and Operation of Heat Transfer Equipment. A special report on a panel discussion. *Chemical Engineering Progress,* v. 57, Jan. 1961, p. 71-80.

Sulfur From Sour Gas for Less Than 1½ Cents Per M.c.f. Includes economics and equipment. ***Hugh S. Pylant.*** *Oil and Gas Journal*, v. 59, no. 4, Jan. 23, 1961, p. 94.

* **Occurrence of *Beggiattoa* Species Relative to Pollution.** A brief look at environments in which all six species of *Beggiatoa* have been found indicates their tolerances for environmental factors are rather wide with one exception. That is an absolute necessity for some H_2S, and traces of O_2. ***James B. Lackey.*** *Water & Sewage Works*, v. 108, Jan. 1961, p. 29-31.

Saline Water Conversion Today. Up-to-date picture of progress in commercial conversion processes. ***Joseph J. Strobel.*** *Chemical Engineering Progress*, v. 57, Jan. 1961, p. 37-41.

Saline Water Conversion by Freezing With Hydrocarbons. Experimental work in crystal growing and washing to remove occluded mother liquor with minimum loss of product water is successful. ***George Karnofsky.*** *Chemical Engineering Progress*, v. 57, Jan. 1961, p. 42-46.

Vapor Reheat Flash Evaporation Without Metallic Surfaces. Technical feasibility of recovering potable water from saline sources shown by theoretical and experimental techniques. ***D. F. Othmer, R. F. Benenati, and G. C. Goulandris.*** *Chemical Engineering Progress*, v. 57, Jan. 1961, p. 47-51.

Heat Transfer in a Spray Column. Pilot-size columns operated as direct liquid-liquid heat exchangers show that the heat-transfer coefficient depends on holdup and fluidity of the hydrocarbon exchange medium. ***Teynham Woodward.*** *Chemical Engineering Progress*, v. 57, Jan. 1961, p. 52-57.

Determination of the Mechanical Properties of Elemental Sulfur. Elemental sulfur has an approximate ultimate tensile strength of 160 psi, and an approximate ultimate compressive strength of 3300 psi, with an approximate modulus of rupture of 200 psi. ***J. M. Dale.*** *Materials Research & Standards*, v. 1, Jan. 1961, p. 23-26.

* **Studies of the Low Temperature Distillation of Hydrogen Isotopes.** Experimental data obtained from the operation of 1.35 in. diameter distillation columns was used for the design of a pilot plant column. This column has been constructed and operated to study the separation of HD from H by fractional distillation. The pilot plant column contains 30 plates and operates with vapor velocities from 0.2 to 2.0 in./sec, and reflux ratios from total to an (L/D) of 2.05. Over-all plate efficiencies were found to vary, as a function of vapor velocity, from 45 to 55%. The over-all plate efficiencies of the pilot plant column are significantly lower than those of the smaller diameter columns. ***T. M. Flynn.*** *Cryogenics*, v. 1, no. 2, Dec. 1960, p. 96-100.

* **A Low Temperature Plant for the Production of Heavy Water.** Describes a plant for the production of heavy water which has been erected for Emser Werke AG, at Domat/Ems, Switzerland. The raw material is natural water which first undergoes seven-fold deuterium enrichment in three electrolysis stages. The gaseous mixture of H and D produced by electrolytic dissociation is cooled to −250 C and thereby liquefied. The liquid then goes to a Kuhn rectifying column where the exchange processes taking place at 23 K result in 400-fold D enrichment. The product of the column is burnt with O and is thereupon passed to a second Kuhn column in which the heavy water concentration is brought up to 99.8%. It is the only known plant for the liquefaction of H which utilizes expansion turbines only, with no preliminary N cooling. ***J. Hänny.*** *Cryogenics*, v. 1, no. 2, Dec. 1960, p. 81-90.

* **Some Developments in Chemical Reaction Engineering.** ***P. G. Menon.*** *Journal of Scientific & Industrial Research*, v. 19A, Nov. 1960, p. 539-541.

* **Coatings and Fabrics for Diaphragms.** The fabrics and elastomers used for diaphragms can have a considerable effect on the efficiency of the instrument in which it is incorporated. Factors affecting performance are discussed. ***E. C. Hemes.*** *Fibres and Plastics*, v. 22, Jan. 1961, p. 13 + 3 pages.

* **Is Desalting the Answer?** Discusses distillation, membrane process, freezing process, and other processes, such as the use of chemicals. *Cast Iron Pipe News*, v. 28, no. 1, Feb.-Mar. 1961, p. 22-25.

* **Five Years of Experience With Desalinization at Morro Bay.** Demonstrates that distilling fresh water from sea water is an effective method of providing a fresh-water supply. ***Albert W. Bruce.*** *American Water Works Association, Journal*, v. 53, Jan. 1961, p. 11-17.

* **Desalted Sea Water Is No Bargain.** Predicts that it will not be, in the foreseeable future and that efficient re-use of water offers more promise of extending present supplies. ***Abel Wolman.*** *American City*, v. 76, Feb. 1961, p. 140 + 1 page.

New Solid-State-Chemistry Methods Yield Ultrapure Materials. Two simple, practical techniques for purifying solids: zone refining and single-crystal production. Methods look promising for making pure metals and organics. ***Rowland E. Johnson.*** *Chemical Engineering*, v. 68, Jan. 23, 1961, p. 147-152.

* **Fresh Water From Saline Waters. An Engineering Research Problem.** General remarks on methods of recovering fresh water from saline and on costs; energy requirements; processes in actual use or proposed. ***Barnett F. Dodge.*** *American Scientist*, v. 48, no. 4, Dec. 1960, p. 476-513.

Add Three to Saline Water Technology. Hydrocarbon-hydrate process and two new heat-transfer methods expand sea water conversion technology. *Chemical Engineering*, v. 68, Jan. 23, 1961, p. 86 + 1 page.

How to Analyze the Calculations for Batch Rectification in Tray Columns. To separate binary mixtures by batch rectification, determine optimum conditions by examining operation at constant reflux ratio or at constant composition of the overhead product. ***Jesse Coates and Bernard S. Pressburg.*** *Chemical Engineering*, v. 68, Jan. 23, 1961, p. 131-136.

* **Propane-Hydrate Process—New Route Opens Up in Desalination Quest.** Utilizes propane as the hydrate former. *Chemical Processing*, v. 24, Feb. 1961, p. 112-114.

Rapid Test Methods for Determination of the Approximate Average Pore Radius, Total Pore Volume and Surface Area Contained in Porous Materials. Pertains to catalyst pellets and granules. ***W. D. Machin, B. I. Parsons, and D. S. Montgomery.*** *Canada, Mines Branch, Technical Bulletin TB* 16, Feb. 1960, 18 pp. (TN26 C16.5tb Contin.)

Batch Distillation of Binary Mixtures Provides Versatile Process Operations. Batch stills are the most economical process units to handle mixture variations and small production runs in chemical operations. ***Benjamin Block.*** *Chemical Engineering*, v. 68, Feb. 6, 1961, p. 87-98.

Winery Keeps Age-Old Process Current. Illustrates how winemakers have modernized their ancient art in keeping with advances of chemical technology. ***C. R. Havighorst.*** *Chemical Engineering*, v. 68, Feb. 6, 1961, p. 76-79.

Carrying Gas Undersea by Flexible Pipeline. Natural gas is to be transmitted from the Canadian mainland to Vancouver Island. A flexible pipeline was preferred to the conventional rigid steel. ***John Polling.*** *New Scientist*, v. 9, Jan. 12, 1961, p. 94-95.

* **Isobaric Vapour-Liquid Equilibria.** Present equilibria data for the systems ethyl alcohol-ethyl benzene and ethyl alcohol-decane. ***S. R. M. Ellis and M. J. Spurr.*** *British Chemical Engineering*, v. 6, Feb. 1961, p. 92-95.

* **Some Recent Vapour-Liquid Contacting Devices.** Operating characteristics are given for the rotary column and for the spiral packing, while for the co-current plate recommendations are given for its mechanical design. *British Chemical Engineering*, v. 6, Feb. 1961, p. 87-91.

* **Effect of Particle Size Distribution in Fluidisation.** Methods of preparing particles in the sieve and sub-sieve ranges of glass ballotini and microspheroidal cracking catalysts are examined. ***W. J. Thomas, P. J. Grey, and S. B. Watkins.*** *British Chemical Engineering*, v. 6, Feb. 1961, p. 80-86.

CHEMISTRY—ANALYTICAL

*** On the Use of Bremsstrahlung for the Determination of Tritium in Aqueous and Organic Systems.** The bremsstrahlung method for the determination of beta radioactivity without gamma radiation is extended to the case of tritium. Using cells made from light materials, excellent results and rough agreement with theoretical estimates were obtained for water containing millicurie amounts of tritium. ***T. Westermark, L. Devell, and N. A. Ghanem.*** *Nuclear Instruments and Methods*, v. 9, Nov. 1960, p. 141-144.

*** Determination of Methacrylate Resins in Lacquer Formulation.** Esters of methacrylic acid can be quantitatively separated from many lacquer formulations through the saponification of other component resins and plasticizers and subsequent treatment with acid. ***M. H. Swann and G. G. Esposito.*** *Official Digest*, v. 33, Jan. 1961, p. 62-64.

*** Use of a Halochromic Effect in Quantitative Chemical Analysis.** The possibility is shown of using azo dyes as analytical oxidation-reduction reagents for the photometric and titrimetric determinations of microgram quantities of a number of oxidizing agents. A linear relationship is established between the decrease of the optical density of the solution of a halochromic azo dye compound and the quantity of an oxidizing agent added. (*In Russian.*) Ispol'zovanie iavlniia galokhromii v kolichestvennom khimicheskom analize. ***A. I. Cherkesov.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec. 1960, p. 651-655.

*** On Cation Masking in Complexometric Titrations by Means of Unithiol.** Unithiol (sodium 2,3-dimercaptopropanesulphonate) can form complex compounds with the ions of many heavy metals. Unithiol complexes with the elements of zinc, germanium and arsenic sub-groups are more stable than corresponding complexonates. Unithiol practically does not react with the ions of the second analytical group, as well as with lanthanum so it may be used for masking in the complexometric determination of these ions in the presence of Zn, Cd, Hg, Pb, Sn, As, Sb, Bi. Unithiol does not displace nickel as well as manganese (in hydroxylamine and triethanolamine mediums) from corresponding complexonates which makes it possible to determine these ions in the presence of metals masked by unithiol. Unithiol is readily soluble in water and is rather stable in solutions. (*In Russian.*) O maskirovanii kationov pri pomoshchi unitiola pri kompleksonometricheskikh titrovaniiakh. ***Iu. V. Morachevskii and L. A. Vol'f.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec.1960, p. 656-660.

*** Certain Azoxycompounds as Reagents for Cations.** The higher selectivity of 2,2'-dihydroxy-azoxybenzene in comparison with like azo and azomethine compounds has been established on reactions with cations. The formation of sensitive, highly selective reagents is possible when an azoxygroup is introduced into the system of polydentate chelants. Reagents are found among the o',o''-dihydroxy-o-azoxyazo compounds and o,o'-bis-(o-hydroxyazo)-azoxy compounds which can be applied for the photometric determinations of calcium, zinc and palladium. (*In Russian.*) Nekotorye azoksisoedineniia kak reagenty na kationy. ***V. M. Dziomko and K. A. Dunaevskaia.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec. 1960, p. 661-667.

*** Quantitative Spectrographic Determination of Admixtures of Rare Earths.** A method is developed for the quantitative spectrographic determination of small amounts of admixtures of La in Pr; Sm, Pr and Eu in Nd; Sm and Yb in Eu; Eu and Tb in Gd; Y, Dy and Gd in Tb; Y in Dy; Er and Dy in Ho; Ho and Tu in Er; Tu in Yb; Dy in Y; Tb in Y; Yb and Tu in Lu; Yb in Tu. (*In Russian.*) Kolichestvennoe spektrograficheskoe opredelenie primeseĭ redkozemel'nykh elementov ***Iu. I. Beliaev and L. A. Krivonos.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec. 1960, p. 711-715.

*** Quantitative Determination of Admixtures in Adiponitrile.** The reduction of 2-cyancyclopentanone-1 and cyclopentanone on a dropping mercury electrode was studied. A method was developed for the simultaneous quantitative determination of 1-imine-2- cyancyclopentane, 2-cyancyclopentanone-1 and cyclopentanone in adiponitrile. (*In Russian.*) Kolichestvennoe opredelinie primeseĭ v adiponitrile. ***A. A. Kalugin, E. M. Perepletchikova, E. N. Zil'berman, Iu. V. Vodzinskii, and A. E. Kulikova.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec. 1960, p. 739-741.

a *** New Titrimetric Method for the Determination of Rhenium in Alloys.** Method is based on the quantitative reduction of Re^{VII} to Re^{IV} with the solution of bivalent chromium salt applying the potentiometric control of the end point. The method has been tested on alloys containing nickel, cobalt, chromium, iron, vanadium, titanium, copper, manganese, molybdenum. (*In Russian.*) Novyĭ titrimetricheskiĭ metod opredeleniia reniia v splavakh. ***D. I. Riabchikov, V. A. Zarinskii, and I. I. Nazarenko.*** *Zhurnal Analiticheskoĭ Khimii*, v. 15, no. 6, Nov.-Dec. 1960, p. 752-754.

b *** Quantitative Determination of Scandium in Tungsten by Means of the Analysis by Activation.** The separation of Sc from W specimens was studied by using Sc_2O_3 as a tracer. Thus after a chemical treatment of the irradiated W specimens, a solution containing Sc without elements of interference for the measurements taken by means of the gamma spectrometer with 100 channels was obtained. The degree of accuracy obtained is of the order of 10-15% and the limit of sensitivity is 0.1 γ Sc per liter. (*In French.*) Dosage de scandium dans les wolframs au moyen de l'analyse par activation. ***L. van Wambeke and G. Pinte.*** *Société Chimique de France, Bulletin*, 1960, nos. 11-12, Nov.-Dec., p. 1901-1902.

c **Colorimetric Determination of Ultramicro Quantities of Calcium Using Glyoxal bis(2-hydroxyanil).** Procedure does not require a preliminary separation of calcium. The complex formed with glyoxal bis(2-hydroxyanil) obeys Beer's law over the range 0 to 10 μg. Colorimetric measurements were made at 535 mμ. ***Kenneth T. Williams and John R. Wilson.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 244-245.

d **Mercurimetric Estimation of Thiols, Aryl Trityl Sulfides, and Disulfides.** Compounds are estimated specifically by titration with mercury(II) ion using *s*-diphenylcarbazone as the indicator. The amount of thiol and aryl trityl sulfide in a mixture can be estimated by determining the thiol indirectly. Many disulfides can be estimated by quantitative reduction and subsequent titration of the resultant thiols. ***Donald C. Gregg, Paul E. Bouffard, and Roger Barton.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 269-271.

e **Neutron Activation Method for the Determination of Traces of Cadmium in Aluminum.** Cadmium in high-purity Al determined in the 1-p.p.b. A sensitivity of 17 p.p.b. was obtained. ***Enzo Ricci and W. D. Mackintosh.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 230-233.

f **Determination of Ethylene-Propylene Copolymer Composition by Infrared Analysis.** Method is carried out with copolymer films, rather than with solutions. Measurements are made of the absorbances at 8.7 and 13.9 microns. Complete analysis, including film preparation, requires only 10 to 15 minutes and is independent of film thickness between rather wide limits. Its precision is comparable to that obtained by solution analysis. ***Peter E. Wei.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 215-217.

g **Continuous Polarographic Determination of Alpha-Amino Acids.** Method applied to ion exchange column effluents. Amino acid concentrations over a wide range up to 6mM may be determined with a standard deviation around 5μM. Method is insensitive to ammonia. ***W. J. Blaedel and J. W. Todd.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 205-207.

h **Use of Four-Electrode Conductometry for the Automatic Determination of Carbon Dioxide and Ammonia in Concentrated Scrubbing Water of Coke Oven Gas.** ***Embrecht Barendrecht and Norbert G. L. M. Janssen.*** *Analytical Chemistry*, v. 33, Feb. 1961, p. 199-203.

i *** Theory and Practice of Continuous Chromatography.** A continuous division of alkali metals K^+-Na^+ and Na^+-Li^+ was conducted in a laboratory installation. The method described was applied to the production of very pure salts of alkali metals. (*In Russian.*) Teoriia i praktika nepreryvnoi khromatografii. ***S. E. Bresler, A. I. Egorov, and B. P. Konstantinov.*** *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1960, no. 11, Nov., p. 1938-1947.

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Liquid Chromatographic Separation of Mixtures of Polymers and Mineral Oil. Small pieces of thin vulcanized natural rubber latex are used as the stationary phase, and a light paraffin hydrocarbon as the mobile phase. The separation is presumably due to the swollen rubber acting as a type of molecular sieve. The relatively small mineral oil molecules are able to diffuse into the rubber and are thus delayed during their passage through the column. ***P. I. Brewer.*** *Nature*, v. 188, Dec. 10, 1960, p. 934-935.

*** Quantitative Chromatographic Methods. II. An Approach to Paper Chromatography of Improved Resolving Power and Reproducibility. III. Factors Controlling the Patterns of Separation of the Amino Acids on Paper Chromatograms. IV. Stabilized Chromatographic Systems of High Resolving Power for Amino Acids.** II. ***Charles S. Hanes.*** III. ***E. H. M. Wade, A. T. Matheson, and C. S. Hanes.*** IV. ***C. S. Hanes, C. K. Harris, M. A. Moscarello, and E. Tigane.*** *Canadian Journal of Biochemistry and Physiology*, v. 39, Jan. 1961, p. 119-194.

Comprehensive Analytical Chemistry. Vol IB. Classical Analysis. Inorganic titrimetric analysis and organic qualitative analysis. ***Cecil L. Wilson and David W. Wilson, editors.*** 878 pp. 1960. Elsevier Publishing Co., New York. (QD75 W69c)

*** Gas-Liquid Chromatography of Terpenes. II. The Dehydration Products of α-Terpineol.** Terpinolene, dipentene, α- and γ-terpinene, $\Delta^{3,5(8)}$-*p*-menthadiene, and 1,8-cineole were identified as the major reaction products. ***E. von Rudloff.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 1-12.

*** Investigations of the Spectroanalytic Mehtod With the Rotating Graphite Disc. I.** The spectroanalytic method with the use of tiny carbon wheels was tested systematically in a solution containing 0.1% Al, 0.1% Fe, and 0.1% Ni. The state of equilibrium is obtained after three to four minutes. With increasing number of revolutions the line intensity decreases. No appreciable effect is obtained from the change in the hydrochloric acid concentration. The arc lines gain intensity in the presence of K, and lose some in the presence of Zn. (*In Hungarian.*) Forgó grafit korongos oldatos színképanalitikai eljárás vizsgálata. I. ***István Benkő and Klára Újhidyné Farkas.*** *Magyar Kémiai Folyóirat*, v. 66, no. 12, Dec. 1960, p. 501-503.

Spectrophotometric Determination of Trace Amounts of Copper in Tungsten Metal Powder. Copper contents as low as 1 p.p.m. can be determined. The method is limited to finely divided tungsten powder. ***A. S. Prokopovitsh and T. E. Green.*** *U. S. Bureau of Mines Report of Investigations* 5720, 1961, 7 pp. (TN21 Un3r Room 290)

Analysis of Yttrium Metal and Yttrium Oxide. Method involves the extraction of zirconium from yttrium with tri-n-octylphosphine oxide. Of the 32 metallic elements added to the yttrium, only niobium interfered seriously. ***J. O. Hibbits, W. F. Davis, G. B. Kauffman, M. R. Menke, and R. T. Williams.*** *U. S. Atomic Energy Commission, APEX*-571, July 1960, 15 pp. (UF767 Un3.1ap Contin.)

*** Ultraviolet Differential Spectrophotometry of Thiobarbiturates.** Automatic recording spectrophotometry for the measurement of thiobarbitals such as thiamylal sodium and thiopental sodium, by virtue of the fact that a change in pH can cause a shift in their absorption spectra. ***Louis A. Williams, Allen T. Hardy, Jerry S. Cohen, and Bennie Zak.*** *Journal of Medicinal and Pharmaceutical Chemistry*, v. 2, no. 6, Dec. 1960, p. 609-615.

The Determination of Hydrogen in Uranium by Mass Spectrometry. Determination requires from 3 to 10 minutes on the mass spectrometer, depending on size of the sample and hydrogen content of the metal. Precision comparable to that of the classical vacuum technique is obtained. ***L. A. Fergason, D. E. Seizinger, and C. H. McBride.*** *U. S. Atomic Energy Commission, MCW*-1462, Jan. 2, 1961, 15 pp. (UF767 Un3.1mc Contin.)

Direct Titration of Calcium and Magnesium in Open-Hearth and Blast-Furnace Slags With the Disodium Salt of Ethylenediaminetetraacetic Acid. New chemical procedure for Ca and Mg which offers advantages over other known methods. Suitability of proposed procedure for routine as well as individual analyses. ***I. N. Bazilevskaya.*** *Henry Brutcher Translation No.* 3896, 3 pp. (From *Zavodskaya Laboratoriya*, v. 22, no. 2, 1956, p. 166-167.) Henry Brutcher, Altadena, Calif.

*** Spectrophotometric Determination of Zirconium With 9-Methyl-2,3,7-trihydroxy-6-fluorene.** New colorimetric reagent for Zr producing a rose-red complex shows maximum absorption, against the reagent blank, at 500 nm and obeys Beer's law from 0.1 to 2.5 ppm. ***A. K. Majumdar and C. P. Savariar.*** *Zeitschrift für Analytische Chemie*, v. 178, no. 5, 1961, p. 352-356.

*** Solochrome Violet R.S. as a New Colorimetric Reagent. II. The Microdetermination of Vanadium.** Sensitive colorimetric reagent for the microdetermination of V in the limits of 0.05 to 6 ppm with a sensitive filter photometer or a spectrophotometer, at 580 nm. A large number of cations up to 100 fold the V amounts do not interfere with its determination. ***H. Khalifa and S. W. Bishara.*** *Zeitschrift für Analytische Chemie*, v. 178, no. 5, 1961, p. 345-352.

*** Spectrophotometric Determination of Traces of Boron in Thorium.** Procedure for the spectrophotometric determination of a few tenths of a part per million of boron in thorium oxide or metal. The error is not likely to exceed ±0.1 ppm for 0.2~1 ppm of B. ***Hiroshi Onishi, Nasumi Ishiwatari, and Hitoshi Nagai.*** *Chemical Society of Japan, Bulletin*, v. 33, no. 12, Dec. 1960, p. 1686-1688.

Determination of Hydrogen in Steel by the Carrier-Gas Method. Two different temperature ranges. ***K. Abresch, W. Dobner, and H. Lemm.*** *Henry Brutcher Translation No.* 4887, 12 pp. (From *Archiv Eisenhüttenwesen*, v. 31, no. 6, 1960, p. 351-354.) Henry Brutcher, Altadena, Calif.

Effect of pH Value of Electrolyte Upon Quantity and Composition of Oxide Inclusions Extracted From Fully Killed Basic Bessemer Steels. pH Values ranging from 6.8 down to 1.0. ***E. Piper, H. Hagedorn, and M. Fröhlich.*** *Henry Brutcher Translation No.* 4888, 8 pp. (From *Archiv Eisenhüttenwesen*, v. 31, no. 6, 1960, p. 355-358.) Henry Brutcher, Altadena, Calif.

*** A Micromethod for the Determination of Hydrogen Sulfide.** The method is based upon procedures involving the precipitation of colloidal lead sulfide, stabilization and particle size control with gum arabic, and quantification in the photoelectric colorimeter. The method is simple, convenient, and rapid, and it has excellent precision in intermediary concentration ranges. It is useful where large numbers of samples must be analyzed simultaneously. ***E. A. Delwiche.*** *Analytical Biochemistry*, v. 1, nos. 4-5, Dec. 1960, p. 397-401.

*** Quantitative Determination of Pentetrazol.** A method for quantitative determination of pentetrazol has been worked out based on the precipitation of the cadmium chloride complex and subsequent complexometric titration of the cadmium content in the precipitate. ***Eva Andersson, Miles Fors, and Jan-Erik Lindgren.*** *Acta Chemica Scandinavica*, v. 14, no. 9, 1960, p. 1957-1960.

*** Radiochemical Determination of Polythionates.** Two radiochemical methods have been developed for the determination of polythionates. In the first method, the polythionates are reacted with sulfite and with a mixture of sulfite and sulfide. The thiosulfate formed in these reactions is then determined with ^{109}AgSCN. In the second method, the sulfide contains the radioactive isotopes ^{35}S and the amount of radioactive thiosulfate formed is instead determined. A correction must be applied for the amount of radioactive thiosulfate formed by isotopic exchange between the sulfide and thiosulfate. ***Nils Herman Schöön.*** *Acta Chemica Scandinavica*, v. 14, no. 9, 1960, p. 2009-2020.

CHEMISTRY—INORGANIC AND GENERAL

*** Studies of Structures of Carbonyl Nickel and of Substituted Derivatives.** Through a spectrographic study of the nickel and of $Ni(CO)_xL_{4-x}$ (x = 1.2.3.) (L:ligand with a P atom), the transformations occurring during the bonding of these compounds as a function of the basicity of the ligand

was followed stage after stage. Thus it was possible to evaluate the orders of the bonds Ni-C and C-O, from $Ni(CO)_4$ to $Ni(CO)L_3$. New data concerning the spectrum of diffusion of gaseous carbonyl nickel were given. (*In French.*) Études de structures du nickel carbonyle et de dérivés substitués. ***Michaël Bigorgne and Arian Zelwer.*** *Société Chimique de France, Bulletin,* 1960, nos. 11-12, Nov.-Dec., p. 1986-2002.

* **New Approach to the Preparation of Sodium Borohydride and Its Use.** The properties of sodium borohydride are summarized. Further, the use of sodium borohydride as a selectively acting agent, as well as a starting material for the preparation of borohydrides of other metals and a great number of boron compounds, such as boron hydrides, amino boranes, trialkyl boranes, alkyl diboranes, esters and thioesters of alkyl boronic and borinic acids and hydrazine boranes are reported. (*In German.*) Neue Wege zur Herstellung von Natriumboranat und dessen Verwendung. ***Friedrich Schubert and Konrad Lang.*** *Angewandte Chemie,* v. 72, no. 24, Dec. 21, 1960, p. 994-1000.

* **Heat Capacity of Cerium Dioxide at High Temperature.** The average heat capacity of cerium dioxide has been determined by the mixing calorimetry method over the temperature range 608-1172 K. The experimental data for the temperature dependence of the mean specific heat are described by equation $cp = 0.08895 + 1.42_2 \cdot 10^{-5}T$. The equation $cp = 0.0847_7 + 2.84_1 \cdot 10^{-5}T$ holds for the temperature dependence of the specific heat. (*In Russian.*) Teploemkost' dvuokisi tseriia pri vysokikh temperaturakh. ***F. A. Kuznetzov and T. N. Rezuchina.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 11, Nov. 1960, p. 2467-2468.

Inorganic Syntheses. This volume contains some sixty-nine independently tested and checked syntheses of inorganic compounds arranged in chapters according to the Mendeleef groups. Covers a wide variety of substances, from active metals to isotopically labeled acids with emphasis placed on coordination compounds and "complexes." ***Eugene G. Rochow, editor.*** v. VI. 272 pp. 1960. McGraw-Hill, New York. (QD151.A1 In7s)

* **Heat Resistance of Aluminum Sulfites.** When heating sulfites to 300 C, the precipitation of SO_2 occurs at different degrees and in function of the composition of the precipitate and according to the conditions of its production. In one specimen with 55 mole SO_2 for one mole of Al_2O_3 the maximum of SO_2 precipitation is at 200 C (1,2 mole). The aluminum sulfites, precipitated during progressive hydrolysis contain, after heating up to 300 C, different amounts of CO_2, from 0.108% to 0.168%. The content of S compounds dissociating at temperatures above 300 C increases in proportion to the increase of the temperature of hydrolysis and to the decrease of the concentration of the initial solution. (*In Russian.*) O ternicheskoĭ ustoĭchivosti sul'fitov aliuminiia. ***P. V. Dybina.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Khimiia i Khimicheskaia Tekhnologiia,* v. 3, no. 5, 1960, p. 902-907.

* **Interaction of Titanium Tetrachloride With Its Dioxide in the Presence of Carbon.** The formation of $TiCl_3$ begins at 900 C with an initial speed above 1000 C. The increase of the partial pressure of $TiCl_4$ in its mixture with argon up to 300 mm of the Hg column intensifies the process. A further low increase of P_{TiCl_4} influences the $TiCl_3$ yield. The optimum yield is observed at the molar ratio C/TiO_2. On the basis of the experimental study of the kinetics of the mixture of TiO_2 and C with $TiCl_4$ a progressive mechanism of heterogenous interaction is offered. (*In Russian.*) Vzaimodeĭstvie tetrakhlorida titana s ego dvuokiʻiu v prisutstvii ugleroda. ***D. M. Chizhikov, G. N. Zviadadze, and V. N. Korsunskaia.*** *Tsvetnye Metally,* v. 33, no. 12, Dec. 1960, p. 42-46.

Studies on Metallic Azides. V. A Study of Cupric Azide Reaction. Spectrophotometric studies revealed that the yellow color formed on mixing dilute aqueous solutions of copper (II) chloride and sodium azide is due to a mono-azido-copper complex, with an absorbancy maximum at 367.5 mμ whose formation constant, K has a mean value of $(3.724 \pm 0.08) \times 10^{-3}$. ***H. K. El-Shamy and M. F. Nassar.*** *Journal of Inorganic and Nuclear Chemistry,* v. 16, nos. 1-2, Nov. 1960, p. 124-130.

Technetium Analogues of Rhenohydrides. Tc analogue of potassium rhenohydride, obtained by reducing Tc-labelled NH_4ReO_4 solution with K in ethylenediamine. Up to 90% of the Tc can be converted into a water soluble potassium technohydride. ***J. G. Floss and A. V. Grosse.*** *Journal of Inorganic and Nuclear Chemistry,* v. 16, nos. 1-2, Nov. 1960, p. 44-47.

Tri- and Tetra-Meric Phosphonitridic Fluoride. $(PNF_2)_3$ and $(PNF_2)_4$, obtained in satisfactory yields by reacting the corresponding phosphonitridic chlorides with argentous fluoride. The mass spectrum proves the assumed cyclic structure for both compounds. ***R. Rätz and Ch. Grundmann.*** *Journal of Inorganic and Nuclear Chemistry,* v. 16, nos. 1-2, Nov. 1960, p. 60-62.

Metallic Reduction of Thorium Tetrachloride. The crude thorium tetrachloride, containing oxygen-bearing compounds, was purified by a double vacuum distillation at 800-900 C, and thorium metal was made in the form of a dense sponge by the reaction of metallic sodium or magnesium with thorium tetrachloride at 800 C. Vacuum arc melting was used to consolidate the sponge metal to ingot form for evaluation of its physical and chemical properties. ***P. C. Good and F. E. Block.*** *U. S. Bureau of Mines Report of Investigations* 5702, 1960, 12 pp. (TN21 Un3r Room 290)

An Accurate Determination of the Crystal Structure of Potassium Pyrosulphate. $K_2S_2O_7$ was investigated by three-dimensional X-ray crystal-structure analysis. ***H. Lynton and Mary R. Truter.*** *Chemical Society, Journal,* 1960, Dec., p. 5112-5118.

Journal of Inorganic Chemistry. English translation of *Zhurnal Neorganicheskoi Khimii,* v. 2, no. 7, 1957. *U. S. Atomic Energy Commission, AEC-tr-*4057, 1960, 426 pp. (UF767 Un3.1ae Contin.)

Alkali and Alkaline Earth Rhenohydrides. Compounds previously described as rhenides are actually complex rhenohydrides of the general formula $Me^I(Re^{III}H_4) \cdot 2\text{-}4H_2O$, at least if prepared by the reduction of perrhenates with potassium in aqueous ethylenediamine. This was demonstrated by *quantitatively* determining the *hydrogen* evolution during thermal decomposition. ***J. G. Floss and A. V. Grosse.*** *Journal of Inorganic and Nuclear Chemistry,* v. 16, nos. 1-2, Nov. 1960, p. 36-43.

* **Some Studies in Inorganic Complexes. VIII. Cobalt(II) and Cobalt(III) With 2-Picolylamine.** Complexes of cobalt(II) and (III) with the chelating ligand 2-picolylamine were prepared and studied. ***G. J. Sutton.*** *Australian Journal of Chemistry,* v. 13, no. 4, Nov. 1960, p. 473-477.

Bis-(pentafluorosulfur) Peroxide. Preparation achieved by allowing pentafluorosulfur hypofluorite (SF_5OF) to react with thionyl fluoride (SOF_2) or with thionyl tetrafluoride (SOF_4) and by subjecting SF_5OF to ultraviolet light. Bis-(pentafluorosulfur) peroxide is a dense, colorless liquid that boils at 49.4° and freezes at −95.4°. ***Claude I. Merrill and George H. Cady.*** *American Chemical Society, Journal,* v. 83, Jan. 20, 1961, p. 298-300.

Fluorine 18 Exchange Between Uranium Hexafluoride and Metal Fluorides. Uranium hexafluoride forms 3 $NaF \cdot UF_6$ with sodium fluoride. The fluorine exchange between UF_6 and NaF was undertaken to further investigate the nature of this addition compound. ***Irving Sheft, Herbert H. Hyman, Richard M. Adams, and Joseph J. Katz.*** *American Chemical Society, Journal,* v. 83, Jan. 20, 1961, p. 291-294.

A Trifluoromethylboron Compound, CF_3BF_2. Metastable compound CF_3BF_2 synthesized by two very different methods. ***Theran D. Parsons, Everett D. Baker, Anton B. Burg, and Gordon L. Juvinall.*** *American Chemical Society, Journal,* v. 83, Jan. 5, 1961, p. 250-251.

Inorganic Complex Compounds Containing Polydentate Groups. XIX. Reaction of Complexes of Manganese(II) and Tetraethylenepentamine With Hydroxide Ions. Determination of the types of complexes formed between tetren and manganese(II) ions in the presence of hydroxide ions. ***Hans B. Jonassen and V. V. Ramanujam.*** *Journal of Physical Chemistry,* v. 65, Jan. 1961, p. 176-177.

* **Is Boric Anhydride a Polymer?** The mechanical properties of glassy boric anhydride were investigated above and below the glass transition temperature. In its mechanical properties glassy boric anhydride is similar to both organic polymers and disperse systems. Softened glassy P_2O_5 below the yield point is in a high elastic state of the same type as with organic

polymers; above the yield point Newtonian flow is observed. These facts indicate that glassy boric anhydride is a linear inorganic polymer with relatively short claims, explaining the relatively low yield value of narrow temperature range of high elasticity. This is probably also the explanation of the similarity between the rheological curves of boric anhydride and disperse systems. (*In Russian.*) Iavliaetsia li bornyĭ angidrid polimerom? ***G. M. Bartenev and A. S. Eremeeva.*** *Vysokomolekuliarnye Soedineniia,* v. 2, no. 12, Dec. 1960, p. 1845-1849.

CHEMISTRY—ORGANIC

Fission Fragments Initiate Ethylene Glycol Synthesis. Irradiation of methanol by fission fragments gives 0.1 lb of ethylene glycol per kwh with 65% chemical conversion. Methanol irradiation experiments were designed to show the effects of temperature, dilution with water, and addition of carbon tetrachloride. Six methanol-vapor samples were irradiated in Argonne's CP-5 reactor and 12 samples in the reactor at Battelle Memorial Institute. It was found that: for irradiations of undiluted methanol, raising the temperature to 250 C had little effect on glycol yield and energy requirements; raising conversion to 15% adversely affected chemical yield and energy input; diluting the methanol with 50 mole % water raised the glycol yield to 67% but did not affect the energy required per pound; and adding 1% CCl_4 to undiluted methanol increased the yield to 66% while reducing energy needed to 4.2 kwh/lb of glycol. Irradiations at Battelle showed that low concentrations of carbon tetrachloride markedly raised yields. Tables compare the results of the experiments conducted at the CP-5 and Battelle reactors. ***Allan K. Wiebe, Willard P. Conner, and Glenn W. Kinzer.*** *Nucleonics,* v. 19, Feb. 1961, p. 50-52.

* **The Heats of Combustion of Some Amino Acids.** The results of determinations of the heats of combustion of six amino acids: dl-threonine, dl-propline, l-oxyproline, dl-ornithine, dl-isoleucine, dl-lysine are described. In the work a calorimeter bomb of diminished size was employed. (*In Russian.*) Teploty goreniia nekotorykh aminokislot. ***V. V. Ponomarev and L. B. Migarskaia.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 11, Nov. 1960, p. 2506-2508.

Organometallic Chemistry. An authoritative survey of the recent scientific developments in carbon-metal compounds. Among the topics covered are organoboranes, organoaluminum compounds and organosilyl derivatives. Also included is new information on benzyne chemistry, vinylmetallics, metallocenes and metal carbonyls. ***H. Zeiss, editor.*** 549 pp. 1960. Reinhold Publishing Corp., N. Y. (QD411 Z36o)

* **A Graphical Densimetric Method for the Structural Analysis of Polynuclear Aromatic Hydrocarbons and Its Application to High-Temperature Coal-Tar Pitches and Pitch Fractions.** Two equations were developed for polynuclear hydrocarbons relating molecular weight with the number of rings in the molecule. In one equation atomic hydrogen-to-carbon ratio is the parameter and in the other density at 20/4 C. The two equations were used in the construction of a diagram. Although this diagram cannot be used for the quantitative statistical evaluation of the structure of such mixtures as coal-tar pitches, it may well serve as a basis for their comparison. ***E. W. Volkmann.*** *Fuel,* v. 39, no. 6, Nov. 1960, p. 455-462.

* **Acetylenic Oxygen Heterocycles.** Verification of the preparation of the first cyclic acetylene as derived by R. Lespieau. ***Franz Sondheimer, Yehiel Gaoni, and Judith Bregman.*** *Tetrahedron Letters,* 1960, no. 26, Dec., p. 25-29.

* **Solvolysis of Ozonides.** Solvolysis of an ozonide is extended to other solvents capable of incorporating active oxygen. ***Erling Bernatek and Tore Ledaal.*** *Tetrahedron Letters,* 1960, no. 26, Dec., p. 30-34.

* **Preparation and Behavior of Simple Quinone Methides.** Dilute solutions of quinone methides may be prepared from either the corresponding benzyl halide or the parent phenol. Thus, 2,6-dimethyl-4-methylene-2,5-cyclohexadienone is obtained in 10^{-5} to 10^{-3} M solution from treatment of a hydrocarbon solution of 3,5-dimethyl-4-hydroxybenzyl chloride with a base, such as triethylamine. ***Leo J. Filar and S. Winstein.*** *Tetrahedron Letters,* 1960, no. 25, Dec., p. 9-16

Advances in Carbohydrate Chemistry. Construction and physicochemical properties of carbohydrates; methods in structural polysaccharide chemistry; the carbonates and thiocarbonates of carbohydrates; tables of properties of 2-amino-2-deoxy sugars and their derivatives; bacterial nucleosides and nucleotides; the biosynthesis of aromatic compounds from D-glucose; polysaccharides of gram negative bacteria; dextran: structure and synthesis; and chitin. ***Melville L. Wolfrom and R. Stuart Tipson, editors.*** v. XV. 445 pp. 1960. Academic Press, New York. (QD321 A95 Vis.)

* **New Flavylocyanines and Merocyanines.** Synthesis of asymmetrical flavylocyanines and merocyanines, with heterocyclic systems as end groups. Mechanism of their formation from flavyllium perchlorate and various heterocyclic systems, in acetic medium, anhydrous sodium acetate working as an accelerator. The optical properties of these products are recalled. (*In French*). Nouvelles flavylocyanines et mérocyanines. ***Th. Photakis.*** *Chimie & Industrie,* v. 84, no. 6, Dec. 1960, p. 908-911.

The Organic Chemistry of Titanium. Discusses Ziegler-Natta type of polymerization catalyst, alkoxides and aroxides of Ti, alkoxides and aroxides of higher molecular weight, including polymers, Ti salts of organic acids, Ti compounds containing N, Ti compounds containing Si, and compounds with Ti-C bonds. ***Isao Shiihara, Willis T. Schwartz, Jr., and Howard W. Post.*** *Chemical Reviews,* v. 61, no. 1, Feb. 1961, p. 1-30.

The Structure and Properties of the Dialkyl Phosphonates. ***G. O. Doak and Leon D. Freedman.*** *Chemical Reviews,* v. 61, no. 1, Feb. 1961, p. 31-44.

The Preparation and Chemical Properties of Thionamides. Review of the literature through 1958 concerned with compounds that contain the groups —C(=S)NRR′ and —C(SR)=NR′, where R and R′ may represent H, a metal, and aliphatic, aromatic, or heterocyclic groups. ***Richard N. Hurd and George DeLa Mater.*** *Chemical Reviews,* v. 61, no. 1, Feb. 1961, p. 45-86.

The Pyrolysis of Neopentyl Chloride: A Wagner-Meerwein Rearrangement in the Gas Phase. ***Allan Maccoll and E. S. Swinbourne.*** *Chemical Society, Proceedings,* 1960, Dec., p. 409.

* **The Chemistry of Naturally Occurring 1,2-Epoxides.** Survey of the chemistry of naturally occurring epoxides with special reference to interesting reactions of the epoxide group. ***A. D. Cross.*** *Chemical Society, Quarterly Reviews,* v. 14, no. 4, 1960, p. 317-335.

* **Auto-oxidation of *n*-Di-isopropylbenzene.** The *n*-di-isopropylbenzene studied was obtained from commercial poly-isopropylbenzenes in the presence of Mn resinate, of hydrogen peroxide of *n*-di-isopropylbenzene and additions such as NaOH, KOH, $Ca(OH)_2$ and Na_2CO_3. The conditions under which *n*-di-isopropylbenzene is oxidized by the air O_2 to a maximum concentration of the hydrogen peroxide of 78% and to a content in the reaction mass of 37% dihydrogen peroxide, were determined. (*In Russian.*) Avtookislenie *n*-diizopropilbenzola. ***S. V. Zavgorodnii and I. N. Novikov.*** *Izvestiia Vysshikh Uchebnykh Zavedenīi, Khimiia i Khimicheskaia Tekhnologiia,* v. 3, no. 5, 1960, p. 863-867.

Three Membered Rings. II. The Stereochemistry of Formation of Some 1,1,2,2,-Tetrasubstituted Cyclopropanes. Cyclopropanes formed by the reaction of α-halo esters, nitriles, or ketones with methyl methacrylate or methacrylonitrile in the presence of sodium hydride. Effect of several variables on the yields and *cis-trans* isomer ratios were determined. ***Layton L. McCoy.*** *Journal of Organic Chemistry,* v. 25, Dec. 1960, p. 2078-2082.

Synthesis of 3-β-D-Ribofuranosyluracil and 1-Methyl-3-β-D-ribofuranosyluracil. Stimulus for the work was the possible use of such compounds as chemotherapeutic agents, metabolite antagonists, and substrates for enzyme specificity investigations. ***James P. Scannell and Frank Worthington Allen.*** *Journal of Organic Chemistry,* v. 25, Dec. 1960, p. 2143-2147.

Kinetics of the Acetolysis of Some Alkyl-Substituted Neopentyl *p*-Bromobenzenesulfonates. First-order rate constants determined at three temperatures and values for ΔH and

ΔS derived for nine esters. ***E. N. McElrath, R. M. Fritz, C. Brown, C. Y. LeGall, and R. B. Duke.*** *Journal of Organic Chemistry*, v. 25, Dec. 1960, p. 2195-2200.

* **A New Method for the Synthesis of Flavone Glucosides.** Since the thermal condensation of (benzyloxybenzoyl) ethyl acetates with phloroberyllia gives access, under certain conditions, to dihydroxy-5,7 benzyloxy-n′ flavones, the effect of acetobromoglucose on these flavones, followed by debenzylation by hydrogenolysis and alkaline deacetylation, leads definitely to the production of β,D-glucosides in 7 of the polyhydroxy-5,7, n′ flavones. The β,D-glucosides in 7 of the apigenines, diosmetines and luteolines were synthesized. (*In French.*) Nouvelle méthode de synthèse des glucosides flavoniques. ***R. Teoule, J. Chopin, and C. Mentzer.*** *Société Chimique de France, Bulletin*, 1960, nos. 11-12, Nov.-Dec., p. 2116-2123.

* **Esters of β-Ketophosphonic Acids. VII. On the Products of Interaction of α-Chlorocyclohexanone, Diethyl Ester of Ethylphosphinous Acid and Sodium Salt of Ethylphosphinous Acid Monoethyl Ester.** (*In Russian.*) Efiry β-ketofosfinovykh kislot soobshchenie. VII. O produktakh vzaimodeĭstviia α-khlortsiklogeksanona s dietilovym efirom etilfosfinistoĭ kisloty i natrievoĭ sol'iu monoetilovogo efira etilfosfinistoĭ kisloty. ***B. A. Abruzov, V. S. Vinogradova, and M. A. Zvereva.*** *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1960, no. 11, Nov., p. 1981-1984.

* **Photooxidation of Azomethane. IV. The Role of Formaldehyde.** Kinetic and tracer studies support the view that the formaldehyde formed in the reaction can act as a source of the oxides of C. These were found to be enriched in C^{13} in the tracer work. ***M. Shahin and K. O. Kutschke.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 73-79.

* **The Preparation, Paper Chromatography, and Color Reactions of Several 5,6-Dihydroxyindoles and 5,6-Diacetoxyindoles.** Colors given by nine dihydroxyindoles with 16 chromogenic reagents are reported. Preparations of several new 5,6-dihydroxyindoles and 5,6-diacetoxyindoles and improved procedures for the syntheses of some known member of these groups are reported. ***R. A. Heacock, M. E. Mahon, and B. D. Scott.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 231-246.

* **Perfluoroalkyl Derivatives of Tin. II. Dimethyltrifluoromethyltin Chloride.** Methyl group cleaved by chlorine in preference to trifluoromethyl from trimethyltrifluoromethyltin and dimethyltrifluoromethyltin chloride; the significance of this is discussed in terms of the electronegativity of the trifluoromethyl group. Nuclear magnetic resonance measurements of trimethyltrifluoromethyltin and dimethyltrifluoromethyltin chloride are given. ***R. D. Chambers, H. C. Clark, and C. J. Willis.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 131-137.

* **Production of N-Containing Heterocycles Through Silicon-Organic Compounds; a New Uric Acid Synthesis.** Diamines containing silyl pass with phosgene under cold conditions and with formation of a ring into the corresponding silyl-containing heterocycles. Thus from N,N′-bis-trimethylsilyl-trimethylene diamine and -tetramethylene diamine, N,N′-bistrimethylsilyl-trimethylene- or tetramethylene-urea are obtained which upon hydrolysis yield trimethylene or tetramethylene urea. (*In German.*) Darstellung N-haltiger Heterocyclen über siliciumorganische Verbindungen; eine neue Harnsäure-Synthese. ***Leonhard Birkofer, Hans Peter Kühlthau, and Alfred Ritter.*** *Chemische Berichte*, v. 93, no. 12, 1960, p. 2810-2813.

* **Concerning Reactions of Naphtholene and Naphthylamines Under the Effect of Hydrogen Sulfite (Bucherer Reaction). VII. A New Production Method for Naphthol-(1)-Sulfonic Acids-(3).** Tetralon-(1) sulfonic acids-(3) and 2-bromo-tetralon-(1)sulfonic acids-(3), under the effect of alkalis, decompose sulfite and form 2-bromo-naphthols-(1). By decomposition of HBr, the bromo-sulfonic acid can be variously transferred into naphthol-(1) sulfonic acids-(3). (*In German.*) Über Reaktionen von Naphtholen und Naphthylaminen unter dem Einfluss von Hydrogensulfit (Bucherer-Reaktionen). VII. Eine Neue darstellungsmethode von naphthol-(1)-sulfonsäuren-(3). ***Alfred Rieche and Helmuth Seeboth.*** *Annalen der Chemie (Justus Liebigs)*, v. 638, nos. 1-3, Dec. 1960, p. 101-110.

Preparation of N,N-Difluoromethylamine and N,N-Difluoroethylamine. Method for preparation. Some of the physical properties of these compounds are listed. ***J. W. Frazer.*** *Journal of Inorganic and Nuclear Chemistry*, v. 16, nos. 1-2, Nov. 1960, p. 63-66.

Cyclization of Some *O*-Substituted Derivatives of N-(3,4-Dimethoxy-β-phenylethyl)glycolamide; Synthesis of (±)-Calycotomine. Attempts to cyclize *N*-(3,4-dimethoxy-β-phenylethyl)alkoxyacetamides with phosphorus oxychloride or phosphorus pentoxide resulted in extensive decomposition and tar formation rather than formation of the desired 1-alkoxymethyl-3,4-dihydroisoquinolines. Cyclization was effected by phosphorus pentachloride, but, in addition, cleavage occurred and a 1-chloromethyl-3,4-dihydroisoquinoline was formed. A possible mechanism for this reaction is discussed. A synthesis of (±)-calycotomine was achieved by cyclization of *N*-(3,4-dimethoxy-β-phenylethyl)acetoxyacetamide with phosphorus oxychloride followed by catalytic hydrogenation. ***F. Benington and R. D. Morin.*** *Journal of Organic Chemistry*, v. 26, Jan. 1961, p. 194-197.

The Chemistry of Maleimide and Its Derivatives. II. Maleimide and *N*-Methylolmaleimide. Maleimide synthesized by preparation and pyrolitic decomposition of 3,6-*endo*-methylene-Δ⁴-tetrahydrophthalimide. A variety of new *N*-substituted derivatives of malemide were prepared. ***P. O. Tawney, et al.*** *Journal of Organic Chemistry*, v. 26, Jan. 1961, p. 15-21.

The Structure of Certain Polyazaindenes. VII. 4-Amino-6-methyl-1,3,3a,7-tetrazaindene and Its Derivatives. Synthesis of a number of new amino tetrazaindenes. ***G. A. Reynolds and J. A. VanAllan.*** *Journal of Organic Chemistry*, v. 26, Jan. 1961, p. 113-117.

Terpenoids. XLVI. Copalic Acid. Copalic acid has the skeleton of agathanedicarboxylic acid and related diterpene acids. On the basis of NMR and mass spectrographic evidence, copalic acid appears to consist of several double bond isomers; in terms of absolute configuration copalic acid corresponds essentially to dehydroeperuic acid. ***T. Nakano and Carl Djerassi.*** *Journal of Organic Chemistry*, v. 26, Jan. 1961, p. 167-173.

Reaction of Some Substituted Methylthiomethyl-benzenes and -naphthalenes With Methyl Iodide. Preparation of some substituted dialkyl-benzyl- and -naphthylmethylsulfonium salts for antitubercular screening. Reaction with methyl iodide was shown to give rise to both the expected sulfonium salts and anomalous products. The effect of substituents in the benzene ring on this reaction was investigated. ***P. Mamalis.*** *Chemical Society, Journal*, 1960, Dec., p. 4747-4753.

Trinitrosylcarbonylmanganese. Preparations of trinitrosylcarbonyl- and triphenylphosphinetrinitrosyl—manganese; infrared spectra and physical properties of the compounds are given, and factors which may influence the relative stability of the nitrosyl carbonyls of manganese are discussed. ***C. G. Barraclough and J. Lewis.*** *Chemical Society, Journal*, 1960, Dec., p. 4842-4846.

Organic Fluorine Compounds. XXVI. Acetoacetyl Fluoride. Acetoacetyl fluoride was prepared from diketene and anhydrous hydrogen fluoride. Its properties and chemical reactivity as an acetoacetylating agent were investigated. ***G. A. Olah and S. J. Kuhn.*** *Journal of Organic Chemistry*, v. 26, Jan. 1961, p. 225-227.

* **The Effects of Alkyl Substitution in Drugs. III. The Spasmolytic Activity of Alkyl-Substituted Xanthene-9-Carboxylic Esters.** A series of xanthene-9-carboxylic acid esters were synthesized as analogues of the diphenylacetic acid ester series, and some of the alkyl substituted derivatives were included to find out whether the expected spasmolytic activity would increase when alkyl substituents were introduced. ***J. Gootjes, A. B. H. Funcke, D. Mulder, H. M. Tersteege, and W. Th. Nauta.*** *Journal of Medicinal and Pharmaceutical Chemistry*, v. 3, no. 1, Jan. 10, 1961, p. 157-165.

* **A New Synthetic Route to β-Haloid-nitro-alkanes.** The new method involves the action of a phosphorus pentachloride on the acetyls obtained by the union of primary β-nitro-alcohols with vinyl alkyl esters. (*In Russian.*) Novyĭ put' sinteza β- galoidnitroalkanov. ***S. S. Novikov and G. A. Shvekhgeimer.***

Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk, 1960, no. 11, Nov., p. 2026-2031.

a • *** The Synthesis of Substituted Arylalkylaminopropionamide Analogues of Lysergic Acid Diethylamide and Their Effect Upon Isolated Cholinesterase Systems.** ***Andrew Lasslo, Pauline D. Waller, Anne L. Meyer, and B. V. Rama Sastry.*** *Journal of Medicinal and Pharmaceutical Chemistry,* v. 2, no. 6, Dec. 1960, p. 617-631.

b • *** Cyclizations of Thiocarbohydrazide and Its Mono-Hydrazones. II. Reactions With Dialkyl Trithiocarbonates.** Thiocarbohydrazide and mono-thiocarbohydrazones react with trithiocarbonates in strongly alkaline solution to form dithiocarbalkoxy-thiocarbohydrazides and their hydrazones, respectively. When heated in the solid state, these compounds are cyclized, with elimination of hydrogen sulfide, to alkylthiothiadiazolhydrazines and hydrazones, respectively. In acid medium, the products of decomposition are mercapto-alkylthiothiadiazoles. ***Jan Sandström.*** *Acta Chemica Scandinavica,* v. 14, no. 9, 1960, p. 1939-1944.

c • *** The Infrared Absorption Spectra of Some Mono-Unsaturated and Saturated Fatty Acids and Esters.** Infrared spectra (from 600 to 4,000 cm^{-1}) of 43 different fatty acids and fatty acid esters in carbon disulfide solution have been recorded. ***Aage Jart.*** *Acta Chemica Scandinavica,* v. 14, no. 9, 1960, p. 1867-1878.

d • *** Synthesis of Organic Compounds With Inorganic Elements, in Which Silicon or Tin Are Linked Directly With Phosphorus or Arsenic.** (*In Russian.*) Sintez element-elementoorganicheskikh soedinenīĭ, v kotorykh kremnīĭ ili olobo sviazany neposredstvenno s fosforom ili mysh'iakom. ***A. B. Bruker, L. D. Balashova, and L. Z. Soborovskiĭ.*** *Akademiia Nauk SSSR, Doklady,* v. 135, no. 4, Dec. 1960, p. 843-846.

e • *** Organolead Methacrylates.** (*In Russian.*) Svintsovoorganicheskie metakrilaty. ***D. A. Kochkin.*** *Akademiia Nauk SSSR, Doklady,* v. 135, no. 4, Dec. 1960, p. 857-859.

The Decarboxylation of Oxamic Acid in Aniline and in *o*-Toluidine. Decarboxylation of oxamic acid does take place at moderate temperatures in polar solvents. In order to ascertain whether or not this decarboxylation follows the same mechanism as that of oxalic acid and malonic acid, kinetic studies of the reaction were carried out in two aromatic amines, aniline and *o*-toluidine. ***Louis Watts Clark.*** *Journal of Physical Chemistry,* v. 65, Jan. 1961, p. 180-182.

f • **Reactions of Phosphine With Aliphatic Aldehydes.** Reaction found to be quite useful as a method of C-P bond formation. Study of possible catalysts other than aqueous mineral acid is also reported. ***Sheldon A. Buckler and V. P. Wystrach.*** *American Chemical Society, Journal,* v. 83, Jan. 5, 1961, p. 168-173.

Cyclopropene Rearrangement in the Polymerization of Sterculic Acid. Polymerization and acetolysis of sterculic acid have been shown to proceed via opening of the cyclopropene ring by carboxylate to yield four isomeric products, identified by oxidative degradation. ***Kenneth L. Rinehart, Jr., Stanley I. Goldberg, Cuthbert, L. Tarimu, and Townley P. Culbertson.*** *American Chemical Society, Journal,* v. 83, Jan. 5, 1961, p. 225-231.

g • *** Reactions of 2,2-Dimethylcyclohexadienones. II. Reaction With Phenyl Magnesium Bromide.** The product of reaction is 2,2 dimethyl-5-phenyl cyclohexene (3) one-(1). (*In German.*) Reaktionen des 2,2-Dimethylcyclohexadienons, 2. Mitt.: Umsetzung mit Phenylmagnesiumbromid. ***H. Budzikiewicz and H. Janda.*** *Monatshefte für Chemie,* v. 91, no. 6, Dec. 1960, p. 1043-1051.

h • *** The Chemistry of Selenophene. XXXI. Reaction of Acid Chloride of 5-Nitroselenophene-2-Carboxylic Acid and 5-Nitro-2-Diazo-Acetoselenophene.** The smooth reaction of the first-mentioned acid with secondary amines leads to the corresponding substituted amines of this acid. The second acid mentioned reacts easily with diazomethane forming 5-nitro-2-diazo-acetoselenophene, whose hydrolysis produces 5-nitro-2-oxyacetoselenophene, whose chlorolysis and bromolysis produce 5-nitro-2-chloracetoselenophene and whose acetolysis produces 5-nitro-2-acetoxyacetoselenophene. (*In Russian.*) Khimiia selenofena. XXXI. Reaktsii khlorangidrida 5-nitroselenofen-2-karbonovoĭ kisloty i 5-nitro-2-diazoatsetoselenofena. ***Iu. K. Iur'ev, E. L. Zaĭtseva, and G. G. Rosanitsev.*** *Zhurnal Obshcheĭ Khimii,* v. 30(92), no. 11, Nov. 1960, p. 3672-3675.

i • *** Hydride Hyperconjugation in 1(3)-Methylazulenes.** Reactions of azulenes with triphenylmethyl perchlorate. ***E. C. Kirby and D. H. Reid.*** *Tetrahedron Letters,* 1960, no. 27, Dec., p. 1-4.

CHEMISTRY—PHYSICAL

j • *** Studies of Different Processes for the Purification of Polonium.** The processes studied are applied to operations of the order of the curie for the purpose of Po preparation by irradiation of Bi with neutrons. There are two stages of treatment: separation of Po from more electropositive impurities (Fe, Bi and Pb) by spontaneous deposition on Ag, Cu or Hg, or by reduction by means of $SnCl_2$; elimination of Ag by precipitation of Po in an ammonia medium. Solid sources easy to store are prepared by electrolytic deposition on Au sheets. (*In French.*) Étude de différents procédés pour la purification du polonium. ***Jules Pauly.*** *Société Chimique de France, Bulletin,* 1960, nos. 11-12, Nov.-Dec., p. 2022-2030.

k • *** Effect of Electronic Properties on the Photosensitivity of Platinum Catalysts.** The fall in catalytic activity of Pt on exposure to light is probably due to photoionization of the active Pt atoms with transition to the inactive ionic form. The photosensitivity of platinum catalysts depends greatly upon the electronic properties of the carrier. The wider the forbidden zone of the carrier (dielectric) the more difficult the return of electrons to the ionized centers, the higher the concentration of photoionized Pt atoms absorbed on the carrier and the greater the fall in catalytic activity. On the contrary a narrowing of the zone of forbidden energies on passing from dielectrics to semiconductors (C, Ge) and to metals (Bi, Pt) where the forbidden zone is absent increases the possibility of electron exchange between carrier and absorbed Pt. Owing to this, the probability of return of a valence electron to the ionized Pt atom increases and there is a diminishing of the fall in catalytic activity upon light exposure. In conformity with this the highest fall in activity on exposure to light is observed in the case of Pt on silica gel, moderate fall in the case of Pt on C and Ge and the lowest in the case of platinum black. (*In Russian.*) Vliianie elektronnykh svoĭstv nositelia na fotochuvstovitel'nost' platinovyk katalizatouov. ***I. V. Krylova, V. A. Ogarev, and N. I. Kobozev.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 11, Nov. 1960, p. 2408-2413.

*** On Characteristics of Ionite Membranes.** Monofunctional ionites are obtained with the like structure of macromolecules, but with different ionogenic groups. Heterogeneous ionite films are prepared differing from each other in the type of ionogenic groups or in the structure of macromolecules. It is established that the electrolytic characteristics of ionite films depend not only on the concentration of ionogenic groups, and the degree of their ionization, but on the structure of macromolecules of the ionite chosen. (*In Russian.*) K voprosu o svoistvakh ionitovykh membran. ***E. B. Trostyanskaya and A. S. Tevlina.*** *Zhurnal Analiticheskoĭ Khimii,* v. 15, no. 6, Nov.-Dec. 1960, p. 681-685.

*** Some Phase Relations of the $BaO-UO_2-O_2$ System.** Mixtures of $BaCO_3$ and UO_2 in different proportions were heated at 1200° in H atmosphere and followingly examined by X-ray powder methods. ***Włodzimierz Trzebiatowski and Andrzej Jabłoński.*** *Nukleonika,* v. 5, no. 10, 1960, p. 587-596.

*** A Contribution to the Study of the Physical Properties of Mercuric Oxide.** A study of the preparation of mercuric oxide by the wet method, or in presence of bromides and cyanides, or from solutions of alkaline iodomercurate(II), and of the preparation of pure 2 HgO·NaI. The preparation of mercuric oxide by the dry method and the identity of the red and of the yellow form of the orthorhombic oxide were determined. (*In French.*) Contribution a l'étude des propriétés physiques de l'oxyde mercurique. ***Pierre Laruelle.*** *Annales de Chimie,* v. 5, Nov.-Dec. 1960, p. 1315-1372.

* **Catalysis by Means of Salts of Metals of Variable Valency in Reactions of Liquid Phase Oxidation.** This study covered the initiation of chains by means of catalysts, the breaking of the chains into catalysts of variable valencies, the physicochemical properties of solutions of salt catalysts in hydrocarbons, the macroscopic stages in the catalyzed oxidation of hydrocarbons and the regulating function of the catalyst in reactions of oxidations. (*In Russian.*) Kataliz soliami metallov peremennoĭ valentnosti v reaktsiiakh zhidkofaznogo okisleniia. ***E. T. Denisov and N. M. Emanuel'.*** *Uspekhi Khimii*, v. 29, no. 12, Dec. 1960, p. 1408-1438.

* **Investigations on the Catalytic Decomposition of Formic Acid as a Function of the Defect Structure of Electron Conductor Titanic Dioxide. Correlation Between the Electric and Catalytic Properties of Defect Conductor Oxides.** ***Z. G. Szabó and F. Solymosi.*** *Acta Chimica Academiae Scientiarum Hungaricae*, v. 25, no. 2, 1960, p. 145-176.

* **Contribution to the Knowledge of Cycloammonium Rearrangement.** When phenothiazine is alkylated with 4-chloromethyl-n-methylpiperidine in an alkaline medium, additionally to the expected substitution product an isomer is formed, the constitution of which has been verified by synthesis to equal 10-(N-methylpyrrolidyl-3-ethyl)-phenothiazine. The mechanism of formation of the isomer was found to be cycloammonium rearrangement via a N-methyl-l-azobicyclo-[1,2,2]-heptyl-cation. (*In German.*) Zur Kenntnis der Cyclammonium-Umlagerung. ***H. Henecka, U. Hörlein, and K.-H. Risse.*** *Angewandte Chemie*, v. 72, no. 24, Dec. 21, 1960, p. 960-963.

* **The Thermal Vibrations in Diketopiperazine.** An analysis of the anisotropic atomic thermal parameters obtained by Degeilh & Marsh for diketopiperazine has shown that the principal rigid-body translations of the molecules are along the directions towards neighboring parallel chains of molecules and are of the order of amplitude 0.13-0.14 Å. The translational amplitude within the chain is a little less. ***Kathleen Lonsdale.*** *Acta Crystallographica*, v. 14, pt. 1, Jan. 10, 1961, p. 37-42.

* **Magnetic Structures of 3*d* Transition Metal Double Fluorides, $KMeF_3$.** Antiferromagnetic structures of $KCrF_3$, $KMnF_3$, $KFeF_3$, $KCoF_3$, $KNiF_3$, and $KCuF_3$, were obtained by neutron diffraction. The magnetic structures and the observed crystallographic distortions are discussed in terms of an indirect exchange mechanism and in terms of the crystal field theory, respectively. ***Vladimiro Scatturin, Lester Corliss, Norman Elliott, and Julius Hastings.*** *Acta Crystallographica*, v. 14, pt. 1, Jan. 10, 1961, p. 19-26.

The Davydov Splitting in the Spectrum of Anthracene Crystals. ***A. R. Lacey and L. E. Lyons.*** *Chemical Society, Proceedings*, 1960, Dec., p. 414.

The Interaction of 1,3,5-Trinitrobenzene and Aqueous Alkali: A Light-Sensitive Aromatic Substitution. ***V. Gold and C. H. Rochester.*** *Chemical Society, Proceedings*, 1960, Dec., p. 403-404.

* **Thermodynamics of Ion Association in Aqueous Solution.** ***G. H. Nancollas.*** *Chemical Society, Quarterly Reviews*, v. 14, no. 4, 1960, p. 402-426.

* **Electron Resonance in Crystalline Transition-Metal Compounds.** Theoretical paper discussing the general theory, the calculation of g values, zero-field splittings, nuclear hyperfine structure, etc. ***A. Carrington and H. C. Longuet-Higgins.*** *Chemical Society, Quarterly Reviews*, v. 14, no. 4, 1960, p. 427-452.

* **Exceptions to Hudson's Rules of Isorotation. The Nuclear Magnetic Resonance Spectra of Anomeric Pyrimidine 2-Deoxy-D-Ribonucleosides.** Nuclear magnetic resonance spectroscopy and optical rotatory dispersion measurements were used to correlate the configurations of anomeric pairs for the 1-(2-deoxy-D-ribofuranosyl) derivatives of 5-methyl- and 5-fluorouracil. The optical rotations of the anomers were found opposite to those expected on the basis of Hudson's rules of isorotation. ***R. U. Lemieux and M. Hoffer.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 110-115.

* **Free Radicals by Mass Spectrometry. XXII. Primary Decomposition Steps in the Mercury-Photosensitized Decomposition of Methanol and Dimethyl Ether.** The decomposition at low pressures proceeds mainly by a dissociation into CH_3O radicals and H atoms. No formation of CH_2OH radicals is observed. A subsidiary reaction to form CH_3 and OH may also be a primary step. Formation of CH_2OH radicals at high pressures is attributed to an abstraction reaction of CH_3O with CH_3OH. ***R. F. Pottie, A. G. Harrison, and F. P. Lossing.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 102-109.

* **The Decomposition of Methane in the Negative Glow.** Studies were made in the negative glow of a d-c discharge at pressures of 0.30 and 0.050 mm. The discharge tube was cooled by liquid or solid N. The main products were ethane, ethylene, and acetylene in addition to H and a nonvolatile product which appeared mainly on the cathode as a solid having the formula $(CH)_n$. Smaller amounts of propane, propene, propyne, butane, butene, butadiene, and pentene were also found. Lowering the temperature of the discharge tube from −196 to −210 C greatly increased the amount of ethylene recovered. ***A. W. Tickner.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 87-95.

* **A Proton Magnetic Resonance Investigation of Rotational Isomerism in 1,1,2,2-Tetrachloro-1-Fluorethane.** The doublet separation in the proton resonance spectrum of the liquid was measured from −53 to 100 C. From the variation of the separation with temperature approximate values of the trans and gauche HF coupling constants were obtained. The values of $\Delta H \approx 400$ cal/mole and $\Delta S \approx 0$ are also consistent with the data. ***R. J. Abraham and H. J. Bernstein.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 39-41.

* **The Donor Characteristics of the Carbonyl Group. II. The Effect of Angular Variations at the Carbonyl Group.** The effect of variations in the angle X-C-X′ (in a typical carbonyl compound XX′C=O) on the carbonyl stretching frequency ($\nu c = o$) is examined in the light of recently published empirical relations between $\nu c = o$ and the ionization potential. ***Denys Cook.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 31-38.

* **The Kinetics and Mechanism of the Cu^{++}-Catalyzed Reduction of Cr^{VI} by Hydrogen in Aqueous Solutions.** The investigations were made in aqueous perchlorate solutions between 160 and 200 C. The mechanism proposed to account for the kinetics gives rise to a rate law whose form is given. ***E. A. Hahn and E. Peters.*** *Canadian Journal of Chemistry*, v. 39, Jan. 1961, p. 162-170.

The Exchange of Deuterium Gas With the Hydrogen Associated With Solid Catalysts. II. Kinetics and Mechanism of the Reaction With Hydrogenated Tantalum. ***W. Keith Hall, W. E. Wallace, and F. J. Cheselske.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 128-132.

Thermodynamic Properties of TiC at High Temperatures. Equilibrium pressure of gaseous Ti in the reaction $TiC(s) = C(graph) + Ti(g)$ has been determined in the range of 2383-2593 K by means of graphite Knudsen cells. Results are expressed by $\log P_{Ti}(atm.) = -(30.830/T) + 7.65$ and the related thermodynamic properties of TiC are calculated. ***S. Fujishiro and N. A. Gokcen.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 161-163.

* **Photometric Determination of Lead Traces in Iron and Steel.** From 0.0001 to 0.05% Pb can be detected in Fe and steel by the method described. After separation of Fe by extraction with diethyl or diisopropyl ether, the lead is shaken out of an ammoniacal solution cotaining potassium cyanide and citrate with dithizone in chloroform and subsequently is photometrically determined with a solution of dithizone in chloroform according to a modified mixed color process. The relative error is ± 5%. (*In German.*) Photometrische Bestimmung von Bleispuren in Eisen und Stahl. ***Siegfried Meyer and Othmar G. Koch.*** *Archiv für das Eisenhüttenwesen*, v. 31, no. 12, Dec. 1960, p. 711-715.

Properties of Lithium Hydride. I. Single Crystals. Single crystals of optical quality LiH have been prepared by slow crystallization of the melt under H at moderate pressure. Measured and reported values of the physical, thermal, chemical, and optical properties of LiH and LiD are compared to those of LiF and NaCl. These properties bear out the predominantly ionic nature of crystalline LiH. The optical properties of LiH differ from those expected by a comparison with the properties of the alkali halides or the other alkali hydrides. ***F. E. Pretzel, et al.***

Physics and Chemistry of Solids, v. 16, nos. 1-2, Nov. 1960, p. 10-20.

a * **Desorption of Surface Oxides of Artificial Graphites.** Raising the temperature progressively to 950 C causes the volatilization of most of the surface oxides which cover only 1/20th of the total surface of the graphite sample. The desorption of the oxides was examined at the temperature of combustion after evacuation of the entire O. The total amounts of desorbed CO or CO_2 as a function of time obey the law of Elovich. (*In French.*) Désorption des oxydes de surface de graphites artificiels. ***Lucien Bonnetain.*** *Journal de Chimie Physique*, v. 58, Jan. 1961, p. 34-46.

b * **Effects of the Surface Active Organic Substances on the Electroreduction of Anions.** Organic cations increase the rate of reduction of anions in the region of adsorption of the organic cations on the Hg electrode. The effect of cations increases with their increasing concentration, with their charge and with their capacity for adsorption. The magnitude of the effect depends on the geometrical structure of the reduced anion and on the magnitude of the organic cation. (*In Russian.*) Vliianie poverkhnostno-aktivnykh organicheskikh veshchestv na elektrovosstanovlenie anionov. ***N. V. Nikolaeva-Fedorovich, B. B. Damaskin, and O. A. Petrii.*** *Collection of Czechoslovak Chemical Communications*, v. 25, no. 12, Dec. 1960, p. 2982-2992.

c **Radiation Chemistry of Polydimethylsiloxane. II. Effects of Additives.** The electron-irradiation of polydimethylsiloxane oil $[-Si(CH_3)_2O-]_n$ in the presence of several additives was studied. The effects of oxygen, mercaptans, H_2, diethyl disulfide, benzene and tetralin on the radiation-crosslinking of polydimethylsiloxane are described. ***A. A. Miller.*** *American Chemical Society, Journal*, v. 83, Jan. 5, 1961, p. 31-36.

d **Antimony in HCl Solutions. Kinetics of Complex Exchange and Hydrolysis Reactions.** Kinetics of the exchange of antimony atoms between Sb(III) and Sb(V) in 7 and 7.7 *f* HCl were studied. The observed exchange curves are complex in general; that is, they consist of two exponential components. The complexity has been shown to be the result of the known slow hydrolysis reaction of Sb(V) in HCl solutions. ***Norman A. Bonner and Wataru Goishi.*** *American Chemical Society, Journal*, v. 83, Jan. 5, 1961, p. 85-99.

e **The Reaction Rates of Polysilicic Acids With Molybdic Acid.** The reaction rates with molybdic acid of polysilicic acids derived from sodium silicate solutions of various mole ratio, concentration and age are reported and approximate kinetic equations derived. In addition, the reactions of polysilicic acid of known chemical composition generated from chlorosiloxanes were studied and the kinetics for the rate of color development with molybdic acid derived. Noncyclic polysilicic acids develop full color in less than five minutes whereas those derived from silicate anions present in sodium silicate solution require up to several hours. ***T. L. O'Connor.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 1-5.

f * **Physico-Chemical Investigation of Selenates. IX. Thermal Decomposition of Magnesium Selenate.** The heating and cooling curves of $MgSeO_4 \cdot 6H_2O$ and $MgSeO_4$ were described and the changes in composition and weight of these salts at different temperatures were studied. Magnesium selenate is less thermally resistant than magnesium sulfate. When heated, it is partly reduced with production of Se(IV) compounds in the solid phase. The thermal decomposition of magnesium selenate does not correspond with the fusion of the salts. (*In Russian.*) Fiziko-khimicheskoe izuchenie selenatov. IX. Termicheskoe razlozhenie selenata magniia. ***N. M. Selivanova, V. A. Shneider, and I. S. Strel'tsov.*** *Izvestiia Vysshikh Uchebnykh Zavedenii, Khimii i Khimicheskaia Tekhnologiia*, v. 3, no. 5, 1960, p. 787-793.

g **The Nuclear Magnetic Resonance Spectra of Some Trisubstituted Silanes. The Electronegativity of Substituents.** The position of the proton attached directly to Si, in the proton magnetic resonance spectra of a series of alkyl- and aryl-trisubstituted silanes, has been measured, and the observed shielding values are compared with the electronegativities of organic groups and with Taft's polar substituent constants. ***D. E. Webster.*** *Chemical Society, Journal*, 1960, Dec., p. 5132-5138.

h * **Electrical Conductivity of the Polyvinyl Alcohol-Zinc Chloride (Cadmium Chloride)—Water System.** When measuring the conductivity and viscosity of 0.6, 1.12, 2.24, 3.2, 6.4, 7.4, 3.8, 9.82 n solutions of $ZnCl_2$ in 30, 20, 10, and 5% solutions of polyvinyl alcohol, it was found that with the increase of the alcohol concentration, the conductivity of the solutions declines and the viscosity increases. The conductivity of PVS films containing a variable amount of dry $CdCl_2$ differs little from PVS films with no $CdCl_2$. This conductivity depends closely on the presence of water in the films. (*In Russian.*) Elektroprovodnost' sistemy polivinilovyĭ spirtkhloristyĭ tsink (khloristyĭ kadmiĭ)—voda. ***N. G. Bardina and P. D. Lukovtser.*** *Zhurnal Prikladnoĭ Khimii*, v. 33, no. 10, Oct. 1960, p. 2234-2238.

i * **Investigation of the Physico-Chemical Properties of Alloys of the $CrSi_2$-$MoSi_2$ System.** The structural diagram was constructed. These alloys form a limited series of hard solutions. The heterogeneous region, consisting of the α and β phases, extend approximately from 35 to 80-85 $MoSi_2$. The microhardness of the α-solid solution varies from 960 to 1120 kg/mm², and of the β-solution from 1270 to 1530 kg/mm². Alloys with 10% $MoSi_2$, 90% $MoSi_2$ and 60% $MoSi_2$ possess maximum hardness. (*In Russian.*) Issledovanie fiziko-khimicheskikh svoĭstv splavov sistemy $CrSi_2$-$MoSi_2$. ***V. S. Aleksashin and V. S. Mikheev.*** *Zhurnal Prikladnoĭ Khimii*, v. 33, no. 10, Oct. 1960, p. 2216-2222.

j **The Sorption of Water Vapor by Charcoal as Influenced by Surface Oxygen Complexes.** A study of water sorption isotherms on charcoal coated with different amounts of variously disposed chemisorbed O shows that it is the O disposed as CO_2 which enhances the sorption capacity of charcoal and not the rest of the combined O. The area of the hysteresis loop also increases with increase in the amount of this O. An appreciable amount of water, representing about one mole per mole of CO_2, is held so firmly by charcoal that it is not desorbed even on drying to zero humidity. This enhances the hysteresis effect, which, however, persists through to a smaller extent, even on complete elimination of the combined O. ***Balwant Rai Puri, K. Murari, and D. D. Singh.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 37-39.

k * **Thermodynamic Characteristic of Aqueous Solutions of Hydrogen Peroxide and Its Reactions With Chlorine at Different Temperatures.** On the basis of thermochemical tests of the reaction at 5, 10, 25 and 35 C, equations of the dependence of ΔH and ΔZ° on temperature for different reactions described were obtained. The values of ΔH, ΔZ° and ΔS° for the above temperatures were calculated. (*In Russian.*) Termodinamicheskaia kharakteristika vodnykh rastvorov perekisi vodoroda i ee reaktsiĭ vzaimodeĭstviia s khlorom pri raznykh temperaturakh. ***K. P. Mishchenko, I. E. Flis, and V. A. Kustodina.*** *Zhurnal Prikladnoĭ Khimii*, v. 33, no. 12, Dec. 1960, p. 2671-2675.

l * **The Rate of Hydrolysis of Iron Chloride in an Aqueous Vapor and Air Medium.** The effects of temperature on the speed of the process were examined. In order to obtain low dispersions in iron oxides, the optimum temperature recommended is about 450 C. The process is speeded up if the content of air in the vapor-air mixture is increased. There should be about 66-70% air in the initial gaseous phase. (*In Russian.*) Skorost' gidroliza khloristogo zheleza v srede vodianogo para i vozdukha. ***M. V. Ionin and V. G. Nikitina.*** *Zhurnal Prikladnoĭ Khimii*, v. 33, no. 12, Dec. 1960, p. 2651-2657.

m * **The Crystal Structure of Some Hafnium-Containing Phases.** In the Hf-Al system, in addition to the Laves-phase $HfAl_2$, the crystaltypes $HfAl_3$, $Hf\sim_{0.75}Al$ and Hf_4Al_5 were detected. A Hf_5Al_3 observed must have been a metalloid stabilized phase. Near 60 at.% Hf a further metastable phase was determined. $HfAl_3$ crystallizes in the $TiAl_3$- and in the $ZrAl_3$ type. In the Hf-Sn system, in addition to Hf_5Sn_3, $HfSn_2$ was detected. The structure of $HfSn_2$ belongs to the $CrSi_2$ type. (*In German.*) Die Kristallstruktur einiger Hafnium-haltiger Phasen. ***H. Boller, H. Nowotny, and A. Wittmann.*** *Monatshefte für Chemie*, v. 91, no. 6, Dec. 1960, p. 1174-1184.

n **Ionic and Free Radical Processes in the Radiolysis of Liquid Methyl and Ethyl Iodides.** The iodides have been irradiated at room temperature with a Co^{60} source at dose rates approximating 10^{19} e.v. hr^{-1} ml^{-1} in air-free samples with added HI and I_2. The reaction products are qualitatively and quantitatively consistent with electron impact cracking patterns as deter-

mined by mass spectrometry. ***H. A. Gillis, R. R. Williams, Jr., and W. H. Hamill.*** *American Chemical Society, Journal*, v. 83, Jan. 5, 1961, p. 17-25.

Electrical Conductivity of Some Organic Solutes in Anhydrous Hydrogen Fluoride. Many organic liquids containing O are miscible with anhydrous hydrogen fluoride. Ethanol, acetic acid and diethyl ether are typical proton acceptors and form highly conducting solutions over most of the concentration range. Trifluoroethanol, trifluoroacetic acid and nitrobenzene are much less extensively ionized in this medium. Perfluorobutyl ether is essentially insoluble. The electrical conductivities for these systems are tabulated and compared. ***Lloyd Quarterman, Herbert H. Hyman, and Joseph J. Katz.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 90-93.

The Decomposition of Solid H_4N_2 Induced by Charged Particle Bombardment. The decomposition of solid hydrazine induced by ion and electron bombardment has been studied. The decomposition was found to proceed through several steps. The stepwise evolution of N_2, H_2 and NH_3 during warmup of the bombarded solid was measured. The absorption spectrum of the bombarded solid showed the absence of NH_3. The results indicate the formation of nitrogen compounds such as triazene which are stabilized at low temperatures and which decompose during warmup of the solid. ***Harold A. Papazian.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 53-55.

* **Chronopotentiometric Determination of Diffusion Coefficients in Melts.** For the determination of diffusion coefficients in molten electrolytes an oscillografic investigation of the time derivative of electrode potential is applied. The method is recommended for measuring diffusion coefficients in melts as an accessible and universal one. The diffusion coefficients of Pb, Zn, Ag, Ni, and Cd in molten mixture of potassium and sodium chlorides were determined. (*In Russian.*) Khronopotentsiometricheskoe opredelenie koeffitsientov diffuzii v rasplavakh. ***Iu. K. Delimarskii, A. V. Gorodyskii, and V. V. Kuz'movich.*** *Collection of Czechoslovak Chemical Communications*, v. 25, no. 12, Dec. 1960, p. 3056-3060.

Diffusion Controlled Growth of a Moving Sphere. The Kinetics of Crystal Growth in Potassium Perchlorate Precipitation. The crystals of potassium perchlorate precipitating from aqueous solution were found to grow with a higher velocity than calculated for pure diffusional rate control. This effect is explained by the convection around the falling crystals, which keeps the concentration near the crystals higher than diffusion alone. ***Arne E. Nielsen.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 46-49.

The Radiochemistry of Beryllium. Concerns the folowing: review of inorganic and analytical chemistry of Be, isotopes of Be, Be chemistry of interest to radiochemists, dissolving samples containing compounds of Be, counting techniques for use with Be isotopes and a collection of detailed radiochemical procedures for Be. ***A. W. Fairhall.*** 58 pp. 1960. *National Academy* of Sciences, Washington, D. C. (QD601 N21.6be)

Some Metal Complexes of Citrate. II. Anion Exchange Studies. The anion-exchange behavior of Co(II), Zn(II), uranyl and Th(IV) was studied in citrate solutions with a strong base anion-exchanger. The highest order complex of Co, Zn and Th with citrate is of the 1:2 type. An anionic thorium-citrate complex is formulated to be $Th(Cit' Cit)^{3-}$. Uranyl forms only a 1:1 complex with citrate. ***N. C. Li and J. M. White.*** *Journal of Inorganic and Nuclear Chemistry*, v. 16, nos. 1-2, Nov. 1960, p. 131-137.

Adsorption of Cobalt, Zinc, Barium and Cesium From Dilute Solutions. It has been shown that a maximum of 97% of the zinc in a solution containing 8×10^{-5} mole/30 ml can be removed from solution by a single filtration through Schleicher and Schuell Blue Ribbon paper at pH 6.5 when the ammonium salt concentration is 3×10^{-6}M. Under similar conditions 70% of the cobalt present in a solution containing 2.8×10^{-9} mole/30 ml can be removed. Only 43-46% of barium and 5-6% of cesium are removed from solutions which have 3×10^{-9} mole/30 ml and less than 10^{-5} mole/30 ml respectively. ***M. H. Kurbator and O. J. Kramme.*** *Journal of Inorganic and Nuclear Chemistry*, v. 16, nos. 1-2, Nov. 1960, p. 109-113.

* **The Application of Aminocompounds in the Polarography of Inorganic Compounds. VIII. The Polarographic Behavior of Bivalent and Trivalent Cobalt in a Glutamine Acid.** The redox system Co^{2+}/Co^{3+} in the presence of glutamine acid and under certain conditions (0.02M to 0.08M glutamine acid, pH 8.7 to 9.7) is almost reversible. The mechanism of reaction and the mechanism of the electrode process were explained and the values of the stability constants of the trivalent Co complex were calculated. The formation of the double stage of the trivalent Co complex in the case of glutamine acid concentration higher than 0.08M was explained by adsorption of the glutamine acid. (*In German.*) Anwendung von Aminoverbindungen in der Polarographie anorganischer Verbindungen. VIII. Das Polarographische Verhalten von zwei-und dreiwertigem Kobalt im Milieu von Glutaminsäure. ***Čang Je-Sia, J. Doležal, and J. Zýka.*** *Collection of Czechoslovak Chemical Communications*, v. 25, no. 12, Dec. 1960, p. 3134-3152.

The Slow Change in Turbidity of Sodium Silicate Solutions. Concentrated sodium silicate solutions in the 1-4 SiO_2/Na_2O ratio range containing 35% or more silicate have been found to have rather stable turbidities over periods of months to a year. Dilute solutions in the same ratio range have slowly increasing turbidities generally accompanied by a small but significant *p*H increase. The turbidity increases are believed to be real and probably result from a very slow polymerization of silicic acid formed by hydrolysis of the silicate ions with OH^- formation. ***P. Debye and Robert V. Nauman.*** *Journal of Physical Chemistry*, v. 65, Jan. 1961, p. 5-9.

The Kinetics of the Oxidation of the Iron(II) Ion by the Tris-(1,10-phenanthroline)-iron(III) Ion. The studies were made of the ion in 0.50 $FHClO_4$ using a rapid-mixing and flow technique. The reaction was shown to be first order with respect to each reagent and the specific rate constant determined to be $3.70 \times 10^4\ F^{-1}\ sec^{-1}$ at 25.0°. ***N. Sutin and B. M. Gordon.*** *American Chemical Society, Journal*, v. 83, Jan. 5, 1961, p. 70-73.

Heat Transfer to a Liquid Film on a Vertical Surface. The minimum flow rate required to maintain a continuous film on the vertical tube is shown to depend both on the liquid temperature and on the temperature of the tube. The results can be correlated as a relation between the average film thickness at the point of breakdown and the product $\sigma\Delta\sigma$, where σ is the liquid surface tension and $\Delta\sigma$ is the difference between the surface tension of the liquid in equilibrium with the tube surface and the bulk liquid surface tension. ***W. S. Norman and V. McIntyre.*** *Institution of Chemical Engineers, Transactions*, v. 38, no. 6, 1960, p. 301-307.

Luminescence From Anthracene Crystals and Its Temperature-Dependence. The variation of the luminescence from crystals of anthracene is reported over the temperature range 4–300 K. Changes occur most markedly over certain ranges, some bands increasing, others decreasing, in intensity. Factors causing the variation are given. ***L. E. Lyons and J. W. White.*** *Chemical Society, Journal*, 1960, Dec., p. 5213-5218.

Liquid-Phase Photolysis. IV. A Stable Adduct of Benzene and Maleic Anhydride. Ultraviolet irradiation of solutions of maleic anhydride in benzene gave a crystalline 2:1 adduct. From chemical and physical evidence, this is considered to be tricyclo[4,2,2,$0^{2,5}$]dec-7-ene-3,4,9,10-tetracarboxylic acid dianhydride. ***H. J. F. Angus and D. Bryce-Smith.*** *Chemical Society, Journal*, 1960, Dec., p. 4791-4795.

The Optical Behaviour of Electrolyte Solutions. The sensitivity of the absorption spectra of ions to the proximity of other ions is discussed. The dependence on the ionic environment of the optical rotation or absorption of several ions has been studied, and dissociation constants obtained from some of the results. The significance of such constants is discussed. ***D. A. L. Hope, R. J. Otter, and J. E. Prue.*** *Chemical Society, Journal*, 1960, Dec., p. 5226-5233.

Anionic Polymerization of Styrene: Conductivity Measurements. Measurements were made, over a wide range of concentrations, of the conductance of solutions which contain the anionically polymerizing species formed from styrene and sodium naphthalene in tetrahydrofuran solution. The active chain ends are shown to be primarily ion pairs with the sodium

gegenion, with a dissociation to free ions which has a dissociation constant of 1.5×10^{-7}. ***D. J. Worsfold and S. Bywater.*** *Chemical Society, Journal,* 1960, Dec., p. 5234-5238.

Thermodynamic Properties of Organic Oxygen Compounds. I. Preparation and Physical Properties of Pure Phenol, Cresols, and Xylenols. The purities of the samples have been established by freezing- and melting-point measurements. Properties which have been measured or computed are: freezing points and the depressions produced by one mole % of impurity, vapor pressure-temperature relationships, boiling points, latent heats of vaporization, second virial coefficients, densities, coefficients of expansion of the homologues which are liquid at 25°, heats of combustion and of formation. ***R. J. L. Andon, et al.*** *Chemical Society, Journal,* 1960, Dec., p. 5246-5254.

Photo- and Semi-Conductance of Organic Crystals. VI. Effect of Oxygen on the Surface Photo-Current and Some Photochemical Properties of Solid Anthracene. VII. Space-Charge Effects in Anthracene. VIII. Photo-Emission of Electrons From Crystals of Aromatic Hydrocarbons. IX. Photo-Conductance in Anthracene and Naphthacene Irradiated in the Vacuum Region. VI. ***A. Bree and L. E. Lyons.*** VII. ***L. E. Lyons and J. C. Mackie.*** VIII.-IX. ***L. E. Lyons and G. C. Morris.*** *Chemical Society, Journal,* 1960, Dec., p. 5179-5206.

The Formation and Photochemical Oxidation of Uranium(IV) Citrate Complexes. The behavior of uranium(IV) in the presence of citric acid was studied, and the stability constant of the complex formed measured over a pH range. The stability constants measured illustrate the effect of hydrolysis of the uranium(IV). The photochemical oxidation of uranium(IV) citrate by oxygen was studied and compared with that of uranium(IV) tartrate obtained in the presence of tartaric acid. ***A. Adams and T. D. Smith.*** *Chemical Society, Journal,* 1960, Dec., p. 4846-4850.

Interaction at a Distance in Conjugated Systems. V. The Ultraviolet Spectra of Phenyl-pyridines and -pyridine 1-Oxides and Their 3'- and 4'-Nitro- and -Amino-derivatives. The ultraviolet spectra of the ionic and neutral species of the compounds mentioned in the title are recorded. The separate and combined effects of hetero-groups and substituents on the energy of transition to the first excited state of biphenyl are discussed. ***A. R. Katritzky and P. Simmons.*** *Chemical Society, Journal,* 1960, Dec., p. 4901-4903.

A Comparative Study of Hydrolysis Rates of Some Indole Alkaloids. Hydrolysis rates of some indole alkaloids have been correlated with structure. The most prominent effect was when the hydroxyl group in many of these bases effectively formed H bonds with the carbonyl of the methoxycarbonyl group. ***M. J. Allen.*** *Chemical Society, Journal,* 1960, Dec., p. 4904-4906.

The Intensity of Ultraviolet-Light Absorption by Monocrystals. IV. Absorption by Naphthacene of Plane-Polarized Light. Measurements on the intensity of light absorption in naphthacene are reported and used to determine the polarizations of four electronic transitions. The experimental results are compared with the predictions of recent theories of the electronic states of the molecules. ***A. Bree and L. E. Lyons.*** *Chemical Society, Journal,* 1960, Dec., p. 5206-5212.

Energy-Entropy Relations in Acylations. I. Effects of Structure and of Polar Substituents. II. Medium Effects. ***H. S. Venkataraman and Cyril Hinshelwood.*** *Chemical Society, Journal,* 1960, Dec., p. 4977-4992.

* **The Solubility of Antimony in Mercury.** Amalgam-polarography and potentiometry methods revealed that the solubility of Sb in Hg is $2.4.10^{-4}$g at/1. In Hg, Co and Sb unite into intermetallic compounds. (*In Russian.*) O rastvorimosti sur'my rtuti. ***A. I. Zebreva and M. T. Kozlovskiĭ.*** *Collection of Czechoslovak Chemical Communications,* v. 25, no. 12, Dec. 1960, p. 3188-3194.

* **Cementation of Nickel and Cobalt From Chloride Solutions by Metallic Iron.** The reactions of contact reduction at low temperatures occur in the kinetic region obeying an equation of the first order. The energies of activation are equal to 10,300 and 10,850 cal/mol for Ni and Co, respectively. At 100 C the process of cementation occurs in the diffusion region

and the film of cement metals exhibits much resistance to the processes of diffusion. (*In Russian.*) Tsmentatsiia nikelia i kobal'ta iz khloridnykh rastvorov metallicheskim zhelezom. ***V. N. Kriukova and A. L. Tseft.*** *Akademiia Nauk Kazakhskoĭ SSR, Vestnik,* v. 16, no. 11, Nov. 1960, p. 24-33.

* **High Temperatures of Oxidation of Carbon Oxide on Spinels.** The spinels of manganese ferrite, copper manganite, and copper chromite are active at 300, 400, and 500 C. Copper manganite also exhibits high activity at 200 C. The effects of the rate by volume, of the temperature of the reaction and of the composition of the gas mixture on the percentage of Co oxidation were examined and the constants of the rate of reaction on a $MnFe_2O_4$ catalyst were calculated. (*In Russian.*) Vysokotemperaturnoe okislenie okisi ugleroda na shpineliakh. ***N. A. Akhundova and M. S. Belen'kiĭ.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Neft' i Gaz,* v. 3, no. 12, 1960, p. 73-78.

COATINGS

Missile Has Special Protective "Skin". Coatings systems and epoxy joint caulking. ***R. M. Wood and T. J. Ashley.*** *Missiles and Rockets,* v. 8, no. 5, Jan. 30, 1961, p. 42.

High Temperatures Foiled by Foam. "Self sacrificing" polyurethane coating applied by spraying. Two-part material bonds tenaciously to most surfaces. *Missiles and Rockets,* v. 8, no. 2, Jan. 9, 1961, p. 30.

Solubility of Linoleic Acid in Aqueous Solutions and Its Reaction With Water. The result of the interaction of linoleic acid and water is a saturated hydroxy fatty acid. This acid gave a positive test for glycol groups with periodic acid oxidation test and appeared to be a tetrahydroxy compound with the exact structure unknown. ***Ahmed Fahmy Mabrouk and L. R. Dugan, Jr.*** *American Oil Chemists' Society, Journal,* v. 38, Jan. 1961, p. 9-13.

Yellowing of Oil Films. Yellowing appears to be a side reaction unrelated to the drying process, but colorless precursors of the yellow compounds are formed as a result of an oxidative process. ***O. S. Privett, M. L. Blank, J. B. Covell, and W. O. Lundberg.*** *American Oil Chemists' Society, Journal,* v. 38, Jan. 1961, p. 22-27.

Effect of Moisture in Furnace Atmosphere During Ground-Coat Firing. Evaluation by mass spectrometry. Results are compared with observed reboiling. ***James F. Benzel, J. F. Uher, F. G. Allenbaugh, and B. J. Sweo.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 1-6.

Infrared Properties of Silicon Monox and Evaporated SiO Films. In wavelength range 1 to 30 μ. ***L. E. Howarth and W. G. Spitzer.*** *American Ceramic Society, Journal,* v. 44, Jan. 1961, p. 26-28.

Which Paint System Should You Use? Discusses the need of basic knowledge of the characteristics of various processes in the selection of paint systems. Spray systems are discussed. *Engineering,* v. 191, Jan. 6, 1961, p. 2-3.

* **Fluid Bed Coating. A Versatile Finishing Technique.** Discusses characteristics of various powders and commercial uses to which the proces has been put. *Product Finishing,* v. 14, Jan. 1961, p. 88-91.

Economical Way to a Quality Finish. Surface preparation; vehicles; characteristics of solvents. ***C. Raymond Syer.*** *Industrial Finishing,* v. 37, no. 3, Jan. 1961, p. 39 + 6 pages.

* **Laboratory Studies on the Properties of Paint Films.** Electroosmosis, water vapor and H permeability, tensile strength and elongation, and reaction to constant stresses were studied for several types of paints. ***D. M. MacDonald.*** *Official Digest,* v. 33, Jan. 1961, p. 7-26.

The Protection of Gas Plant and Equipment From Corrosion. The Protection of Structural Steel Against Corrosion. A guide for plant and equipment. ***J. C. Hudson.*** *Chemistry & Industry,* 1961, no. 1, Jan. 7, p. 3-11.

* **Ink Properties of Lithol Reds.** ***Donald H. Stubbs.*** *American Ink Maker,* v. 39, Jan. 1961, p. 34 + 7 pages.

* **Behaviour of Tin Alloy Coatings.** Comments from a letter replying to a series of questions put by a manufacturer who wished to use tin-on-zinc coatings to protect steel exposed to occasional moisture but not to full weathering. ***S. C. Britton.*** *Tin and Its Uses,* no. 50, 1960, p. 6-8.

* **The Role of Petroleum Waxes in Paper Converting.** Packaging end uses, including food board, waxes, paper, glassine, specialty papers, tissue stock, laminations and others. ***J. F. Butterworth.*** *Paper, Film and Foil Converter,* v. 35, Jan. 1961, p. 40-44.

* **X-Ray Methods and the Paint Industry.** Properties of X-rays that make them valuable in chemical analysis and control are described. Four ways in which they can be used for these purposes are illustrated. ***H. A. Leibhafsky and W. W. Welbon.*** *Official Digest,* v. 33, Jan. 1961, p. 42-50.

* **Trimethylolpropane Applications in Alkyd Resins.** ***George H. Wiech.*** *Official Digest,* v. 33, Jan. 1961, p. 120-134.

* **Measurement of Rheological Properties.** Measurement is discussed in terms of the ideal and in practical terms covering the various approaches and methods currently incorporated in commercially available equipment. ***Donald W. Brookfield.*** *Official Digest,* v. 33, Jan. 1961, p. 89-94.

* **Painting Shot Blasted Steel Plates in Shipyards.** Analysis of requirements. Processes of rusting, methods of removing scale. *Current Engineering Practice,* v. 3, no. 5, Nov. 1960, p. 21-23.

Possible Uses of Animal Fats in the Paint Industry. Uses in paint and varnish and raw material industries; modification of alkyd resins with beef suet; preparation of beef suet fatty acids; and cooking of resins based on phthalic anhydride. ***J. van Sande.*** *Paint Technology,* v. 24, Dec. 1960, p. 23-30.

Developments in the Tall Oil Industry. Distillation techniques now permit production of very pure samples of fatty and resin acids. ***W. Krohnstad.*** *Paint Technology,* v. 24, Dec. 1960, p. 36 + 1 page.

Don't Buy Paint on Price Alone. Emphasizes performance life. ***R. L. Gillogly.*** *Oil and Gas Journal,* v. 59, no. 4, Jan. 23, 1961, p. 81-83.

Use of the Stormer Viscometer for Testing Rotogravure and Flexographic Inks. ***R. Cummings.*** *Materials Research & Standards,* v. 1, Jan. 1961, p. 30-31.

Synthetics in Paper Coating. Describes the methods of coating with synthetic materials and gives examples of the type of application for which these materials are suited. ***E. G. Curphey.*** *Plastics (London),* v. 26, Jan. 1961, p. 113-114.

* **Protective and Decorative Coatings.** Sintering and fluidized bed processes are discussed. *Applied Plastics,* v. 4, Jan. 1961, p. 33 + 2 pages.

* **Polythene Coated Papers.** Possible future applications of polythene and other plastics as coating materials. ***J. V. Eller.*** *Fibres and Plastics,* v. 22, Jan. 1961, p. 24-25.

* **Drying Oils and Acids in Alkyds.** Alkyd resins from oils; alkyd resins from fatty acids; and applications. ***William M. Kraft.*** *Paint Industry Magazine,* v. 76, Jan. 1961, p. 6-9.

* **The Design of Unsaturated Polyester Resins for Surface Coatings.** Above is discussed in relation to the problems of "air-inhibition" and gel-time. ***V. F. Jenkins, A. Mott, and R. J. Wicker.*** *Oil & Colour Chemists' Association, Journal,* v. 44, Jan. 1961, p. 42-60.

Insulating Lacquers. A review. ***R. H. Chandler.*** *Paint Manufacture,* v. 31, Jan. 1961, p. 28-29.

Emulsion Paints. A review. *Paint Manufacture,* v. 31, Jan. 1961, p. 24 + 4 pages.

* **Aging Characteristics of Film Insulated Copper Wire in Transformer Oil.** ***G. F. Lipsey and P. W. Juneau, Jr.*** *Insulation,* v. 7, Feb. 1961, p. 31-36.

Flooding and Floating in Paints. Causes of flooding and floating and the associated phenomenon of Bénard cell formation are not completely understood. Some of the theories proposed and suggested cures are discussed. ***L. A. Logue.*** *Paint Manufacture,* v. 31, Jan. 1961, p. 5-9.

Paper-Coating Clay From Coarse Georgia Kaolins by a New Attrition-Grinding Process. Research was undertaken to devise an acceptable method for converting coarse kaolins, such as paper-filler-grade clays, to paper-coating-grade clays, thereby increasing the value and extending the life of southeastern paper-clay deposits. ***I. L. Feld, T. N. McVay, H. L. Gilmore, and B. H. Clemmons.*** *U. S. Bureau of Mines Report of Investigations* 5697, 1960, 20 pp. (TN21 Un3r Room 290)

* **Thin Metal Layers.** Description of the production of thin metal layers by vacuum evaporation; vacuum conditions; description of a technical coating plant; questions concerning the selection of material for the vapor sources. (*In German.*) Dünne Metallschichten. ***E. Ritter.*** *Radex Rundschau,* 1960, no. 6, Dec., p. 389-394.

CONTROL SYSTEMS, COMPUTERS, AND SYSTEMS ENGINEERING

Programming for Contour Milling. Careful planning for drafting and programming for numerical control of milling machines can result in markedly increased savings. Such a system at Norair is described. ***Frank A. Twitchell.*** Paper from "Numerical Control Today", p. 48-52, 1960. American Society of Tool and Manufacturing Engineers, Detroit, Mich. (TJ1204 T61n Over.)

Numerically Controlled Inspection. Tape-controlled inspection is a logical companion to tape-controlled machining. Together, they lead to impressive time and cost savings in metalworking. ***William B. Johnson.*** Paper from "Numerical Control Today", p. 29-31, 1960. American Society of Tool and Manufacturing Engineers, Detroit, Mich. (TJ1204 T61n Over.)

Planning Job Shop Automation. Versatile special machines, numerical control and efficient tooling help to keep production costs down at the General Electric large steam turbine-generator department. The basic planning concepts of GE engineers are applicable to virtually all types of parts and all plants. ***T. W. Black.*** Paper from "Numerical Control Today", p. 18-23, 1960. American Society of Tool and Manufacturing Engineers, Detroit, Mich. (TJ1204 T61n Over.)

Can You Afford Numerical Control? Although numerical control has resulted in significant savings on hundreds of machining operations, it is not always a sure-fire way to cut costs. Tool engineers must analyze each operation to find out where numerical control will pay. ***Myron S. Curtis.*** Paper from "Numerical Control Today", p. 7-9, 1960. American Society of Tool and Manufacturing Engineers, Detroit, Mich. (TJ1204 T61n Over.)

* **Two Experimental Learning Machines.** Demonstrates that these machines behave in a manner which could be described as learning, and they can be organized to provide a skill not detailed by the designer. ***P. Huggins.*** *Institution of Electrical Engineers, Journal,* v. 6, no. 72, Dec. 1960, p. 702-705.

Analogue Telemetry Equipment and Systems. I. An air to ground television installation and an automatic radome evaluation equipment are described and it is shown, in later sections of the article, how these earlier equipments have formed part of a continuous development programme. ***R. E. Young.*** *Electronic Engineering,* v. 33, Jan. 1961, p. 16-20.

* **A Digital Computer Program for Secondary Network Analysis.** ***R. F. Cook and J. N. Powers.*** *Power Apparatus and Systems,* 1960, no. 51, Dec., p. 941-948.

* **General Philosophy and Objectives of Power Plant Automation.** ***W. L. Chadwick.*** *Power Apparatus and Systems,* 1960, no. 51, Dec., p. 1034-1036.

* **Circuit Blocks Aid Initial Design.** The logical elements described will not eliminate the work of the circuit designer. They will, however, save much time and unnecessary study in

the initial design stages. ***G. A. Clark.*** *Automation Progress*, v. 5, Dec. 1960, p. 405.

Dual-Purpose Synchronizing and Dependent-Drive Time-Sharing for Point-to-Point Numerical Control. Machine tool drives, used in conjunction with numerical positioning, can generally be classified into two categories; some form of servo drive or an open-loop drive, such as a multiple gear train and on-off clutches. Dual-purpose synchronization will permit the use of either form of machine drive with the same numerical control equipment. By time-sharing one clutch drive system between two axes of a machine, it is possible to approach the performance of a separate machine drive for each axis at the cost of a single drive. ***George W. Younkin.*** *IRE Transactions on Industrial Electronics*, v. IE-7, no. 3, Dec. 1960, p. 15-21.

Problems Encountered and Solved in Starting Up of Computer Control Systems. Techniques for improving the accuracy and safety of computer-controlled systems are presented. The scope of the paper is limited to those techniques which are being used successfully in operating computer-controlled processes. ***Robert P. Adams.*** *IRE Transactions on Industrial Electronics*, v. IE-7, no. 3, Dec. 1960, p. 10-14.

* **Statistical Analysis of Certain Binary Division Algorithms.** The Markov chain model introduced to analyze division methods will prove of use in any iterative process where each iteration may be viewed as the mapping of a number of independent quantities into groupings of these same quantities. Use of Bayes' Axiom in assuming all operands randomly distributed will often prove valuable in determining some crude performance figures for an arithmetic algorithm. ***C. V. Freiman.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 91-103.

* **Computer Memories—A Survey of the State-of-the-Art** Computer memory developments of the last decade, the present state, and efforts for improvements are surveyed. Principles of storage and selection of random-access memories; magnetic decoding and load-sharing switches; transfluxor memories, and other topics are included. ***Jan A. Rajchman.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 104-127.

* **Statistical Analysis of Logic Circuit Performance in Digital Systems.** Reviews methods for combining statistical distributions of a set of parameters to obtain the distributions of the performance characteristics. Both algebraic and numerical methods are considered. Transistor Resistor Logic circuits are then analyzed in more detail. ***E. Nussbaum, E. A. Irland, and C. E. Young.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 236-244.

* **Cyclic Codes for Error Detection.** Cyclic codes are defined and described from a new viewpoint involving polynomials. The basic properties of Hamming and Fire codes are derived. The potentialities of these codes for error detection and the equipment required for implementing error detection systems using cyclic codes are described in detail. ***W. W. Peterson and D. T. Brown.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 228-235.

* **Pattern Recognition Using Autocorrelation.** A class of techniques for character recognition is described. These techniques are characterized by the property that the only parameters of the input which are used are those which are independent of the position of the character. ***L. P. Horwitz and G. L. Shelton, Jr.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 175-185.

Electronic Analog of the Human Recognition System. Describes a system for pattern recognition made up of electronic logic elements which has many of the characteristics of humans for recognizing patterns. In particular, the recognition is invariant for size and will tolerate a specified amount of tilt or figure rotation. The electronic components or organs which make up this system consist of delay lines, logical elements such as "and" circuits, and photoreceptors. ***J. R. Singer.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 61-69.

* **Data Processing and Higher Management.** Here are some of the reasons why higher management does not define policies for the data processing department—and what the data processing man can do to defend his position. ***Richard W. Dayhuff.*** *Data Processing*, v. 3, Jan. 1961, p. 18-19.

* **Approximate Calculation of Pneumatic Nozzle/Flapper Devices.** Particulars are supplied for calculating the characteristics for the static behavior of pneumatic devices required, for instance, as basic components for pneumatic transmitters, controllers and positioners. Approximate values are given for the relationship between the air pressure and the position of the flapper and also for the forces acting upon it under various operating conditions. Finally, it is shown how the described method of calculation can be applied for designing a pneumatic amplifier. (*In German.*) Näherungsweise Berechnung von pneumatischen Düse-Prallplatte-Systemen. ***R. Winckler and K. Kramer.*** *Regelungstechnik*, v. 8, no. 12, Dec. 1960, p. 439-446.

* **Developments in the Logical Organization of Computer Arithmetic and Control Units.** A batch-fabricated technology will stimulate the design of ultra-concurrent computers which use perhaps millions of elements that may be individually slow. In the near-term, smaller computers will probably continue to have fundamentally conventional organizations, but will be increasingly equipped with modest versions of the innovations that already are appearing in large machines. ***F. S. Beckman, F. P. Brooks, Jr., and W. J. Lawless, Jr.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 53-66.

* **Self-Organizing Systems—A Review and Commentary.** The network synthesis problem is recast in terms of redundant information removal, multivariable curve-fitting and expansion in orthonormal functions. Recognition network structures and the learning process are described. ***J. K. Hawkins.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 31-48.

* **Steps Toward Artificial Intelligence.** Emphasizes the class of activities in which a general purpose computer, complete with a library of basic programs, is further programmed to perform operations leading to ever higher-level information processing functions such as learning and problem solving. ***Marvin Minsky.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 8-30.

Gray-to-Binary Converter Handles Least Significant Bit First. Summary of various conversion methods includes a technique in which conversion circuits deliver the least significant bit first, rather than last. Advantage of this technique is that reversal of word-bit order is not required. ***Gilbert David Beinhocker.*** *Electronics*, v. 34, no. 4, Jan. 27, 1961, p. 56-58.

Controlling With Magnetic Cores. Theory, confirmed by experiments, indicates that magnetic memory techniques may be employed to provide features unobtainable with conventional AFC and APC systems. Though still experimental, the techniques are presented here. ***Michael Cooperman.*** *Electronic Industries*, v. 20, Feb. 1961, p. 116-120.

* **An Electronic Analogue Computer for a Coal Transportation Problem.** The transportation problem and linear programming are defined and an electronic analogue of the problem and its optimum solution is described. ***E. G. Anderson.*** *Institution of Electrical Engineers, Proceedings*, v. 108, pt. B, no. 37, Jan. 1961, p. 43-47.

Experiments on Magnetic Tape Readout With an Electron Beam. In the beam readout system described in this paper, the magnetic tape is bent over a cylinder and the electron beam is made to pass across the recorded track. The electrons close to the tape form a cycloid pattern. This pattern is deflected across the entrance slit of a Faraday collector, thereby producing an output signal corresponding to the recorded information. ***M. M. Freundlich, S. J. Begun, D. I. Breitzer, J. B. Gehman, and J. K. Lewis.*** *I.R.E. Proceedings*, v. 49, Feb. 1961, p. 498-509.

* **The Evolution of Programming Systems.** Many of the basic ideas, though known and applied in the very early days of electronic computing, have been carried to a high degree of implementation in the last few years. A variety of techniques are available and each has its place. They can be brought together into a special system as required for the purpose at hand. ***William Orchard-Hays.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 283-295.

* **Computers in Automatic Control Systems.** Recent applications of computer control include the automatic control of boiler operation in an electric generating station, the adaptive auto-

pilots for piloted aircraft, and the automatic control of load dispatching in electric power distribution. ***John G. Truxal.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 305-312.

ELECTRICAL ENGINEERING

° **A Locus Tracer for Frequencies Between 10 kc/s and 200 mc/s.** The paper explains the duties of a locus tracer and the demands placed on it. From this information it is derived how to dimension the individual parts of such a device. Finally the embodiment of a locus tracer is described for measurements on two-terminal and four-terminal networks between 10 kc/s and 200 mc/s. (*In German.*) Ein Ortskurvenschreiber fur Frequenzen zwischen 10 kHz und 200 MHz. ***P. Thilo.*** *Frequenz*, v. 14, Dec. 1960, p. 403-412.

° **Analysis of Pilot-Wire Differential Line Relaying by Circle Diagrams in the Complex Plane.** Selection of basic parameters of longitudinal differential line relaying can be performed with sufficient accuracy by studying the diagrams in the complex plane. The pilot relaying cannot be obtained for a length of the line of the connection exceeding the critical. A correct choice of the resistance of one terminal set of the pilot relaying measured from the side of the connection line (Z_n) exhibits much influence on the selectivity and sensitivity of the pilot relaying. (*In Russian.*) Analiz prodol'nykh differentsial'nykh zashchit linii metodom diagramm v kompleksnoĭ ploskosti. ***V. L. Fabrikant.*** *Elektrichestvo*, 1960, no. 12, Dec., p. 40-46.

° **Thermoelectric Refrigeration and Its Application.** Devices were produced which prove the feasibility of thermoelectric power generation as well as refrigeration. ***R. S. Lackey and W. L. Wright.*** *Electro-Technology*, v. 67, no. 1, Jan. 1961, p. 68-73.

° **Concerning Parametric Circuits With Non-Linear Reactances and Resistances.** Reports about some results of research into the dependence of the oscillation buildup effect on the shape of the characteristic of the nonlinear element in parametric circuits. The considerations hold for nonlinear reactances and resistances. The calculating method is briefly outlined and equivalent circuits for the nonlinear reactance and resistance are devised for further calculations on parametric circuits. (*In German.*) Über parametrische Schaltungen mit nichtlinearen Blind- und Wirkwiderständen. ***Karl-Heinz Steiner.*** *Archiv der Elektrischen Übertragung*, v. 14, Nov. 1960, p. 482-486.

° **Vacuum as an Insulator.** Reviews the properties of vacuum when it behaves as an electrical insulator, the factors which determine breakdown, and the hypotheses advanced to account for the breakdown. Conclusions are drawn which suggest the direction which future developments might take. ***R. Hawley.*** *Vacuum*, v. 10, no. 4, Sept. 1960, p. 310-318.

On Parametric Excitation With Current Saturable Inductances. A parametric amplifier circuit is described. The nonlinearity involved is abrupt and a method of analysis of "relaxation oscillations" is preferred to techniques assuming quasi-linearity. This leads to a physical understanding of the cycle of oscillations as well as quantitative relationships which are helpful to the designer. ***Noah S. Prywes.*** *Franklin Institute, Journal*, v. 270, no. 6, Dec. 1960, p. 468-491.

° **Water-Turbine-Driven Induction Generators.** Outlines the main differences between motor and generator operation and considers the excitation of generators, in particular when provided by system capacitance. Results are given of tests on machines to ascertain the practical effects of uncontrolled excitation and switch-in currents. Information is given about some advantages arising from the absorption of reactive current produced by long transmission lines and the reduction in voltage drop on lines delivering power. The equipment necessary for control, protection, starting and synchronizing is described, as well as technical matters concerned with drying out windings and checking phase rotation. Three typical schemes are described and a list of eixsting and planned installations is given. ***C. L. C. Allan.*** *Institution of Electrical Engineers, Proceedings*, v. 107, pt. A, no. 36, Dec. 1960, p. 529-550.

° **The Resistance of Sheet Insulation to Surface Discharges.** Investigations show that a satisfactory classification of insulating materials with respect to their resistance to deterioration and breakdown by surface discharges in air is given by time-to-breakdown tests using simple rod and plate electrodes. It is necessary to circulate dry air over specimens to avoid the formation of semiconducting films, and comparison should be made only between specimens of similar thickness. The discharge resistance of most materials is reduced by increasing the ambient temperature or by applying mechanical strain. Results of tests on thin films and sheets of several polymers and on both glass and paper laminates of 1-3 mm thickness are given. ***J. H. Mason.*** *Institution of Electrical Engineers, Proceedings*, v. 107, pt. A, no. 36, Dec. 1960, p. 551-568.

Definitions of Resonance and Exact Conditions for Resonance in Some Electrical Circuits. I. Definitions of Resonance for Series and Parallel *LCR* Circuits. Six definitions of resonance are distinguished and considered for the series *LCR* circuit. The corresponding exact conditions are derived for each of the four variables and their practical significance discussed. Some of the results for the parallel *LCR* circuit are briefly considered. ***Edward J. Burge.*** *American Journal of Physics*, v. 29, no. 1, Jan. 1961, p. 19-23.

Screening Effect of a Circular Disk. A theory of the effect of a circular metal disk in screening the electric field of a pole and the magnetic field of a radio-frequency dipole (eddy current screening) on the axis is developed in terms of spheroidal functions. The screening effectiveness is defined as the ratio of the screened to the unscreened field and curves are given showing its variation along the disk axis. ***T. S. E. Thomas.*** *American Journal of Physics*, v. 29, no. 1, Jan. 1961, p. 37-39.

A Convenient Transformer for Matching Coaxial Lines. A line transformer is described which involves two sections of line, each having the impedance of one of the lines to be joined, and arranged so that the three resulting changes of impedance cancel at one frequency. It is shown that in certain cases the transformer has practical advantages over other types in common use. ***R. Bramham.*** *Electronic Engineering*, v. 33, Jan. 1961, p. 42-44.

Rf Hall Effect in a Superconductor. The rf Hall field in a superconductor is calculated for the applied dc magnetic field and the rf electric field both parallel to the metal surface. A two-fluid model and specular reflection boundary conditions are used to solve the transport problem in the limits of the classical and the extreme anomalous skin effects. It is found in both limits that the rf Hall effect is nonzero. ***G. Dresselhaus and M. S. Dresselhaus.*** *Physical Review*, v. 120, 2nd ser., no. 6, Dec. 15, 1960, p. 1971-1974.

Electrical Structure of PbS Films. Conductivity and Hall mobility measurements were made on both the dark and the photoexcited carriers. The dark conductivity is independent of frequency below 100 Mc/sec. It increases by almost an order of magnitude over a decade in frequency and then becomes constant again at higher frequencies. Studies of the photoconductive decay yield the same time constant at dc and microwave frequencies, supporting the picture that the same photocarriers are responsible for the dc and microwave photoconductivity. ***D. P. Snowden and A. M. Portis.*** *Physical Review*, v. 120, 2nd ser., no. 6, Dec. 15, 1960, p. 1983-1995.

A Wide Band Voltage Controlled Oscillator. The circuit is essentially that of an LC oscillator, the frequency of which is varied by electronically switching a number of fixed capacitors across the tuning inductance. The various factors affecting oscillator linearity and stability are discussed, and the circuit diagram of an oscillator covering the range 1·5Mc/s to 3·0Mc/s with a maximum non-linearity of 0.5% is given. ***M. A. Weston.*** *Electronic Engineering*, v. 33, Jan. 1961, p. 2-5.

° **Soil Thermal Characteristics in Relation to Underground Power Cables. I. Problem and Objective. II. Soil Types: Identification and Physical Properties. III. Soil-Moisture Characteristics. IV. Soil Thermal Resistivity; Typical Field Values and Calculating Formulas. V. Practical Application; Trench Design and Construction. VI. Measurement Techniques.** I. ***R. J. Wiseman and R. W. Burrell.*** II. ***William A. Del Mar, R. W. Burrell, and C. A. Bauer.*** III. ***L. H. Fink.*** IV. ***W. A. Sinclair, F. H. Buller, and C. B. Benham.*** V. ***A.***

S. Brookes and M. H. McGrath. VI. ***A. W. W. Cameron and A. S. Brookes.*** *Power Apparatus and Systems,* 1960, no. 51, Dec., p. 792-856.

a * **Fundamental Characteristics and Problems for Practical Use of Self-Excited Inverters.** This paper briefly discusses the various fundamental characteristics of self-excited inverter and points out most of their problems in the conventional application. At first, various important characteristics of inverters are numerically analyzed with the use of nondimensional circuit parameters. Secondly, some design examples are discussed. ***Tadashi Kawai.*** *Mitsubishi Denki Laboratory Reports,* v. 1, no. 4, Oct. 1960, p. 1-20.

* **Open-Circuit Noise in Synchronous Machines.** In order to predict the noise level of a synchronous machine the paper develops equations to represent the permeance and m.m.f. variation at the stator bore. From these two equations expressions are derived which give the force variation causing vibrations in the core. The method for calculating the amplitude of, and number of nodes associated with, any particular harmonic is given. From this the loudness of the noise in decibels is obtained. ***J H. Walker and N. Kerruish.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. A, no. 36, Dec. 1960, p. 505-512.

Conditional-Switching Terminal Guidance (A Terminal Guidance Technique for Satellite Rendezvous. This is a terminal guidance technique for satellite rendezvous utilizing a constant thrust rocket motor, a computer, and attitude control. For any given thrust level, this technique can reduce the relative range to any desired value in a minimum of time for an interceptor on a collision course. A terminal guidance law is formulated and mechanized. The generalized range performance trajectories and system errors are presented. ***Anthony L. Passera.*** *IRE Transactions on Aeronautical and Navigational Electronics,* v. ANE-7, no. 4, Dec. 1960, p. 110-118. (TK1 In6.6a Vis.)

* **The Investigation of the Characteristics of Germanium Diodes.** Investigations of a large number of current-voltage impulse and static characteristics of thermistors, point-contact and junction germanium diodes shows that in all cases the "turnover" of the characteristic is caused by the heating of the sample. ***I. M. Senderikhin and P. V. Sharavskii.*** *Soviet Physics - Solid State* (Cover-to-cover translation of *Fizika Tverdogo Tela*), v. 2, Jan. 1961, p. 1359-1366.

* **Absorption of Infrared Radiation by Electrons in p-Type Silicon.** Assuming the well-known structure of the conduction band of *n*-silicon, the absorption in it can be explained by two fundamental mechanisms: scattering of electrons by atomic oscillations and by lattice defects. The problem is discussed from these viewpoints on band of formulas. ***V. A. Yakovlev.*** *Soviet Physics - Solid State* (Cover-to-cover translation of *Fizika Tverdogo Tela*), v. 2, Jan. 1961, p. 1471-1475.

New Microwave Link to Span Continent. The new system will cover more than 5,000 miles, cost about $53 million and include more than 260 relay stations. *Electronics,* v. 34, no. 3, Jan. 20, 1961, p. 29.

* **Analysis of a Constant-Input-Flow Hydraulic System.** An analysis of the system is discussed and its application to a paper form feeder carriage in a printer is described. A nonlinear differential equation is derived, based on stated assumptions and lumped oil parameters. The equation is linearized and solutions for motor velocity and peak pressure, both versus time, are determined. The analytical results show the effect of system parameters on system acceleration, steady-state volumetric efficiency, and peak pressure. A limited amount of experimental data has been collected and good correlation between theoretical prediction and experimental results for acceleration time and peak pressure has been achieved. ***S. C. Titcomb.*** *IBM Journal of Research and Development,* v. 5, no. 1, Jan. 1961, p. 44-55.

* **An Electrical Analogue for Heat Waves in an Exothermic Medium.** Describes the design, construction, and operation of an electrical analogue used for simulating the conditions of propagation of heat waves in an exothermic medium. ***R. T. Ackroyd, J. Houstoun, J. W. Lynn, and E. Mann.*** *Institution of Electrical Engineers, Proceedings,* v. 108, pt. B, no. 37, Jan. 1961, p. 33-36.

* **The Effectiveness of Intersystem Tie Lines for Feeding a Local Distributed Load.** Intersystem lines of electrical transmission can be used economically for the above purpose if the intersystem line operates under reversible conditions and if the consumers are distributed not far from its route. For 400-600 kw lines the minimum suitable power of a substation for feeding a distributed load is 4 to 10 Mwa, and the best power is 15 to 120 Mwa. (*In Russian.*) Ob effektivnosti ispol'zovaniia mezhsistemnykh linīĭ elektroperedachi dlia pitaniia mestnoĭ raspredelenoĭ nagruzki. ***Lo Baĭ-Chan.*** *Elektrichestvo,* 1961, no. 1, Jan., p. 1-8.

* **Printed-Circuit Motors: How Far Will They Go?** Radical new design of direct-current motor—printed-circuit armature, permanent-magnet field—now comes as direct-drive servo motor. *Power,* v. 105, Feb. 1961, p. 74-75.

* **What Happens in a Short Circuit?** How the short circuit behaves in first few cycles of its existence is important in selecting proper circuit breakers. Newly proposed ASA Switchgear Standards have spurred interest in this problem. ***Norman Peach.*** *Power,* v. 105, Feb. 1961, p. 184-185.

ELECTROCHEMISTRY

Electric Car With Fuel Cell Power. The fuel cell driving an electric car is feasible technically right now. Current studies indicate that economic feasibility is a long way off. ***M. Eisenberg.*** *SAE Journal,* v. 69, Jan. 1961, p. 43.

* **Electrolytic Polishing Studies of High Temperature Nickel Alloys.** Explanation of processes taking place during electrolytic polishing test procedure and results. (*In German.*) Untersuchungen zum elektrolytischen Polieren hochwarmfester Nickellegierungen. ***Günter Häussler and Volker Pätzold.*** *Neue Hütte,* v. 5, Nov. 1960, p. 665-674.

* **On Some Problems of the Preparation and Investigation of High-Purity Metallic Gallium.** Modern methods of preparing metallic gallium are discussed with particular reference to the two-step electrolysis starting with aluminate liquor as crude material. A qualitative and quantitative description of the impurities is presented. (*In German.*) Einige probleme der herstellung und prüfung des reinstgalliums. ***E. Papp and K. Solymár.*** *Acta Chimica Academiae Scientiarum Hungaricae,* v. 24, no. 4, 1960, p. 451-474.

* **The Electrodeposition of Precious Metals.** Such factors as workshop conditions, plant and equipment, solution control, and labor are discussed, together with pretreatment of the surfaces to be coated. ***P. G. L. Vivian.*** *Product Finishing,* v. 14, Jan. 1961, p. 62-67.

Studies on the Electrochemistry of Carbon and Chemically-Modified Carbon Surfaces. Some factors which influence the behavior of carbon electrodes in contact with aqueous sodium chloride solutions are analyzed. A concentration cell method for identifying finely divided carbon electrodes as cation- and anion-responsive types has been developed. Commercial graphites investigated have been found to be cation-responsive; however, anion-responsive electrodes have been prepared by the adsorption on graphite of certain organic compounds. Possible half-cell reactions are discussed for both electrode types and the electrochemical capacities of some electrodes are reported. ***Bill B. Arnold and George W. Murphy.*** *Journal of Physical Chemistry,* v. 65, Jan. 1961, p. 135-138.

* **Measurement of the Thickness of Electroplates by Electrolytic Stripping Method Stripping Solution for Chromium Over Copper and Brass Bases.** ***Prem Behari Mathur and Nithiyanandan J. Paul.*** *Electroplating,* v. 2, no. 3, Aug.-Dec. 1960, p. 19-21.

* **Effect of Addition Agents in Copper Plating From the Sulphamate Bath.** The effect of several addition agents on bath performance, polarization and nature of the deposit has been studied. Gelatin, glue, EDTA and sulphosalicylic acid increase the cathode polarization and give bright deposits. ***S. Venkatachalam and T. L. Rama Char.*** *Electroplating and Metal Finishing,* v. 14, Jan. 1961, p. 3-5.

* **Experiences With Some Bright Nickel Plating Solutions.** ***G. Buss.*** *Electroplating and Metal Finishing,* v. 14, Jan. 1961, p. 15-17.

Hard Chrome Plating of Cast Iron. Difficulty is sometimes experienced in depositing a continuous coating of chrome plate on iron castings. The possibility that this arises from variations in microstructure and graphite form and distribution is investigated. ***T. J. Glover.*** *B.C.I.R.A. Journal,* v. 9, no. 1, Jan. 1961, p. 95-102.

* **Plating Anodes.** Discusses the importance of the anodes in electroplating. Talks specifically of alloy, copper and nickel anodes and anode slime. Also gives some British standard specifications for anodes. ***D. J. Fishlock.*** *Electroplating,* v. 2, no. 3, Aug.-Dec. 1960, p. 7-18.

ELECTRONICS

* **Correlation of Monthly Median Transmission Loss and Refractive Index Profile Characteristics.** The difference in the monthly mean values of the refractive index at ground level and at one kilometer above the ground level is often used for the purpose of predicting the annual cycle of radio transmission loss. The present study investigates the possibility of utilizing differences to heights other than one kilometer. A comparison of 100 megacycles per second transmission loss recorded over twenty-one paths with various refractivity differences from the surface to three kilometers reveals that the surface value of the refractive index yields as good a correlation as any of the refractive index differences due to the high correlation between the surface values and these differences. ***B. R. Bean and B. A. Cahoon.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation,* v. 65D, no. 1, Jan.-Feb. 1961, p. 67-74.

* **An Introduction to Network Synthesis.** Characteristics of network synthesis, equations for terminated networks, description of network configurations and types, some definitions of network types, some basic network structures, networks synthesized by recognition and other problems are discussed. ***Louis Weinberg.*** *Electro-Technology,* v. 67, no. 1, Jan. 1961, p. 85-104.

* **A Study of the Local Properties of Photomultipliers.** (*In French.*) Étude des caractéristiques locales des photomultiplicateurs. ***Pierre Cachon.*** *Annales des Telecommunications,* v. 15, nos. 9-10, Sept.-Oct. 1960, p. 220-251.

Advances in Electronics and Electron Physics. Inelastic collisions between atomic systems, field ionization and field ion microscopy, velocity distribution in electron streams, electron probe microanalysis, television camera tubes are discussed. ***L. Marton, editor.*** v. XIII. 454 pp. 1960. Academic Press, New York. (TK161 A95e Vis.)

The Phonon Drag Component of the Thermoelectric Power of the Alkali Metals at Low Temperatures. It is shown by means of a "baby spectrum" that the use of a results in the domination of the phonon drag effect by the transverse-like phonon modes, and in the watering down of any "bulge" effect of the Fermi surface. Rough calculations are made that show that one can get qualitative agreement with experiment over at least part of the temperature range from 2 to 20 K. ***M. Bailyn.*** *Philosophical Magazine,* v. 5, ser. 8, Oct. 1960, p. 1059-1085.

* **On the Mechanism of Origin of the Cathode Spot in the Negatively Charged Electrodes in Gas-Discharge Plasma.** By means of oscillographic methods and velocity plotting the appearing of the cathode spot during the impact of the Hg drop or of the metallic particle was investigated. A classification of the mechanism involved as a function of the voltage range, of the role of the local increase of pressure caused by the drop, and of the charge of the metallic particle flying to the electrode was obtained. (*In Russian.*) O mekhanizme vozniknoveniia katodnogo piatna na otritsatel'no zariazhennykh elektrodakh v plazme gazovogo razriada. ***Ia. Ia. Urdis.*** *Radiotekhnika i Elektronika,* v. 5, no. 12, Dec. 1960, p. 2026-3032.

Measuring Amplitude and Phase. Numerical methods for determining amplitude and phase of moderately wide band noise contaminated by extraneous noise are studied. Shows that amplitude and phase can be determined from a pair of finite moving averages on the sample noise record. ***N. R. Goodman.*** *Franklin Institute, Journal,* v. 270, no. 6, Dec. 1960, p. 437-450.

Potential Distributions in a Low-Pressure Thermionic Converter. A plane diode model of a low-pressure cesium-filled thermionic converter is treated. It is assumed that all ions and electrons are created at the surface of the hot cathode with a Maxwellian distribution corresponding to the cathode temperature. The charged species are then assumed to move through the plasma, consisting of electrons, ions, and neutral cesium atoms, as free particles under the influence of their mutual space charge field. ***Peter L. Auer.*** *Journal of Applied Physics,* v. 31, Dec. 1960, p. 2096-2103.

Photoemission and Related Properties of the Alkali-Antimonides. The high photoelectric efficiencies of these materials are attributed to the ability of the excited electrons to traverse relatively large distances (250 A) without overwhelming energy losses, rather than to negligibly small electron affinities. The efficiency is found to be strongly dependent on the percentage of the electrons which are excited into states above the vacuum level. ***William E. Spicer.*** *Journal of Applied Physics,* v. 31, Dec. 1960, p. 2077-2084.

A Theory of Incoherent Scattering of Radio Waves by a Plasma. The frequency spectrum, as well as the amplitude, of the scattered radiation is calculated. Particular attention is paid to the part of the spectrum which corresponds to small Doppler shifts, this being the region of greatest significance in connection with the phenomenon of incoherent scattering from the ionosphere. ***J. P. Dougherty and D. T. Farley.*** *Royal Society, Proceedings,* v. 259, ser. A, Nov. 22, 1960, p. 79-99.

* **Scattering by a Narrow Unidirectionally Conducting Infinite Strip.** The scattering of a plane electromagnetic wave of wave number k by a unidirectionally conducting infinite strip of width $2a$ is investigated. The problem is formulated in terms of an integral equation whose solution is obtained by a well-known procedure in the form of a series in powers of ka. Expressions for the far-zone fields and the first two terms in the series for the total scattering cross section are obtained. ***S. R. Seshadri.*** *Canadian Journal of Physics,* v. 38, Dec. 1960, p. 1623-1631.

* **Propagation of Electromagnetic Waves Along a Thin Plasma Sheet.** Shows that a thin ionized sheet will support a trapped surface wave. The effect of a constant and uniform magnetic field is to modify the phase velocity and polarization of the surface wave. The essential features are illustrated by numerical results for selected values of the electron density, collision frequency, and gyro frequency. The effect of locating the plasma sheet near and parallel to a conducting plane is also considered. In this situation other modes of a waveguide type are possible in addition to the surface wave. ***James R. Wait.*** *Canadian Journal of Physics,* v. 38, Dec. 1960, p. 1586-1594.

* **Radio Wave Absorption of Several Gases in the 100 to 117 kMc/s Frequency Range.** Describes a technique for the measurement of the absorption characteristics of millimeter radio waves over a wide pressure range and presents the results of measurements made with this technique for carbon monoxide, nitrous oxide, sulfur dioxide, and nitrogen dioxide. ***C. O. Britt, C. W. Tolbert, and A. W. Straiton.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation,* v. 65D, no. 1, Jan.-Feb. 1961, p. 15-18.

* **East-West Effect of VLF Mode Transmission Across the Earth's Magnetic Field.** The effect of a constant transverse magnetic field is analyzed for the propagation of VLF electromagnetic waves about the earth. These waves are considered to be propagating by modes in a parallel plate waveguide. The lower boundary of the guide is considered to be a perfect conductor, while the upper boundary is assumed to be a sharply defined, semi-infinite, homogeneous plasma with a constant magnetic field applied. The source of these waves is an infinite number of short, horizontal, cophased dipoles, uniformly spaced parallel to the constant magnetic field vector. ***D. Dobrott and A. Ishimaru.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation,* v. 65D, no. 1, Jan.-Feb. 1961, p. 47-52.

*** Radar Antenna Calibration Range at Charleston Naval Shipyard.** The range consists of two steel antenna towers which are installed 1385 feet apart in a flat, unobstructed area of Charleston Naval Shipyard. One tower supports an SP antenna which radiates energy. The second tower is designed to allow rotation of the AN/SPS-8 antenna about both its vertical and horizontal axes. ***E. R. Wilson.*** *Bureau of Ships Journal*, v. 10, no. 1, Jan. 1961, p. 2 + 2 pages.

The Hall Effect and Related Phenomena. Conduction processes in semiconductors, description and methods of measurement of the transport properties, conduction in anisotropic solid, the behavior of typical semiconductors, a summary of the electrical properties are discussed. ***E. H. Putley.*** 263 pp. 1960. Butterworth Inc., Washington, D. C. (QC611 P98h)

Swept Langmuir Probe System for Intense Gas Discharges. The apparatus described provides a pulse of biasing voltage to a probe system so that electron temperatures up to 2×10^5 K and ion densities up to 5×10^{14}/cc can be measured. The system consists of a low impedance voltage sweep generator, a transformer-coupled measuring circuit and a logarithmic amplifier. The apparatus can be used to sample a portion or the whole of the electron energy distribution by using double probes of equal or greatly unequal areas. The probe plots are displayed directly on an oscilloscope. ***H. W. Jones and P. A. H. Saunders.*** *Journal of Scientific Instruments*, v. 37, Dec. 1960, p. 457-459.

*** Phenomena at the Metal-Dielectric Junctions of High-Voltage Insulators in Vacuum and Magnetic Field.** With sufficiently high voltage applied to a ceramic insulator with flat faces in contact with flat electrodes in air at pressures of the order of 10^{-8} to 10^{-5} mm Hg, discharge phenomena occur at the negative metal-dielectric junction. ***M. J. Kofoid.*** *Power Apparatus and Systems*, 1960, no. 51, Dec., p. 991-999.

*** The Calculation of Attenuation Constants for Radio Noise Analysis of Overhead Lines.** Intrinsic impedence of the earth and of conductors, practical calculation of attenuation components, comparison of calculated and measured attenuation constants are discussed. ***G. E. Adams and L. O. Barthold.*** *Power Apparatus and Systems*, 1960, no. 51, Dec., p. 975-981.

Negative Striations. Striations of high velocity and small luminosity, traveling towards the anode, were studied in some neon discharges with rotating mirror and photomultiplier techniques. These "negative" waves seem to be associated with a frequency multiplication of positive striations, which occurs near the head of the positive column. They are not usually observed at the anode. ***J. R. M. Coulter.*** *Physica*, v. 26, Nov. 1960, p. 949-953.

*** Broad-Band Microwave Quarter-Wave Plate.** The quarter-wave plate is widely used as the conversion device between linearly polarized wave and circularly polarized wave. Theories and techniques of broad-banding are described for three types of quarter-wave plate which are obtained by utilizing two perpendicular modes in circular waveguide; they are dielectric slab type, differential type and additional type. ***Takashi Kitsuregawa, Shojiro Nakahara, and Seibei Tachikawa.*** *Mitsubishi Denki Laboratory Reports*, v. 1, no. 4, Oct. 1960, p. 21-52.

*** Development of Silicon Rectifiers of High Reverse Voltage.** The breakdown voltage of a p-n junction is related directly to the resistivity. In fused Si rectifiers, the breakdown voltage is usually much lower than the value predicted from empirical formula. In order to prevent the lowering of breakdown voltage by the surface effect, care must be taken not to cause the surface contamination by ambient gases. ***Junji Shimizu.*** *Mitsubishi Denki Laboratory Reports*, v. 1, no. 4, Oct. 1960, p. 53-62.

*** Useful Radiation From an Underground Antenna.** An underground antenna delivers power to the surrounding conductive medium, and a fraction of the power goes out as radiation above the surface. This fraction is denoted the "radiation efficiency". It is expressed in simple terms for two types of underground antennas. The first and simplest is a vertical loop in a submerged spherical radome. The second is a submerged horizontal insulated wire with each end connected to a ground electrode. ***Harold A. Wheeler.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation*, v. 65D, no. 1, Jan.-Feb. 1961, p. 89-91.

*** Characteristics of Waveguides for Long-Distance Transmission.** The principal properties of waveguide—the medium of communication—are discussed in some detail. The particular significance of helical and coated waveguides is pointed out and the design formulas included. The phenomenon of mode conversion-reconversion, which is peculiar to a waveguide communication system, is discussed in general. ***A. E. Karbowiak and L. Solymar.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation*, v. 65D, no. 1, Jan.-Feb. 1961, p. 75-88.

*** Parameters of a Semiconductor Triode Under Frequency Conversion Conditions.** The dependences between the parameters of a triode of this type under conditions of amplification and conversion were studied. By analyzing very simple theoretical models, the character and possible quantitative relationships in these dependences were evaluated. More accurate quantitative dependences were determined. (*In Russian.*) Parametry poluprovodnikovogo trioda v rezhime preobrazovaniia chastoty. ***M. E. Movshovich.*** *Elektrosviaz'*, v. 14, no. 12, Dec. 1960, p. 29-37.

*** Long Range Communication With Aircraft.** The various available methods of radio communication with aircraft are discussed. Concludes that the high frequency systems continue to be the most useful and their reliability can be improved by continuing use of ionosphere propagation information. ***J. H. Meek.*** *Canadian Aeronautical Journal*, v. 7, no. 1, Jan. 1961, p. 33-34.

*** Shortwave Receiver of High Frequency Accuracy for Fixed and Mobile Radio Stations.** Describes Rel 445 E 311 radio receiver. ***Gerhard Pilz.*** *Siemens Review*, v. 28, no. 1, Jan. 1961, p. 24-26.

Radio Frequency Noise From Environment of Hypersonic Vehicles. Reviews the state of art in estimating the radio frequency noise from the environment of a hypersonic vehicle and points out areas requiring considerable effort. It can be safety said that the radiation due to the incoherent processes is less than that due to a corresponding black body. The possible mechanisms for excitation of and radiation by plasma oscillations need further investigation before anything conclusive can be stated regarding their role in the emission of RF noise. A conjecture is also made about mechanisms for coherent radiation. ***Mahendra Singh Sodha.*** *IRE Transactions on Aeronautical and Navigational Electronics*, v. ANE-7, no. 4, Dec. 1960, p. 119-123. (TK1 In6.6a Vis.)

Exploring the Atmosphere With Radio Waves. Discusses the ionosphere as a hypothesis to explain the range of radio waves, ways of sounding the atmosphere, transition of the atmosphere to interplanetary gas, radar observation of meteors, and effects of ionospheric winds and atmospheric tides on signal strength. ***H. Bremmer.*** *Philips Technical Review*, v. 22, no. 3, 1960-1961, p. 61-70.

Noncylindrical Helix Waveguide. Small uniform deformations of the cross section of helix waveguide perturb the circular electric waves slightly. From these perturbations the added circular electric wave loss is found in a uniformly deformed helix waveguide. For a nonuniformly deformed helix waveguide Maxwell's equations are converted into generalized telegraphist's equations. By an approximate solution for small deformations, mode conversion and circular electric wave loss are found. ***H. G. Unger.*** *Bell System Technical Journal*, v. 40, no. 1, Jan. 1961, p. 233-254.

*** A Survey of Tunnel-Diode Digital Techniques.** Results have been most promising in high-speed random-access memories and in dynamic logic systems utilizing multiphase clock sources. Discusses the major techniques that have been reported plus some that have been developed by the authors and their associates at Bendix Research Laboratories. ***R. C. Sims, E. R. Beck, Jr., and V. C. Kamm.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 136-146.

Uniformity of Electrical Current Flow in Cylindrical Semiconductor Specimens With Cylindrical Metallic End Caps. The distribution of current is computed in a cylindrical semiconductor specimen provided with cylindrical metallic end caps of the same diameter as that of the specimen and electrical lead wires of much smaller diameter. Nonuniformity of the longitudinal current density of 1% or less can be obtained in

specimens with electrical resistivities at least 200 times greater than that of the end caps if the lengths of the specimens are at least equal to their diameters and if the length of each end cap is at least 0.3 diam. ***R. Simon, J. H. Cahn, and J. C. Bell.*** *Journal of Applied Chemistry*, v. 32, no. 1, Jan. 1961, p. 46-47.

Considerations on the Solar Cell. The collection efficiency in solar cells is treated by a new method in which all the effects of the solar spectrum and the absorption curve are contained in a single function readily obtained by numerical integration. The method is illustrated by a detailed study of the effects of surface recombination, body recombination and junction depth in silicon cells. The method is also generalized to include built-in electric fields, and calculations are given for silicon. Sufficiently strong fields to improve the collection efficiency markedly can be produced in some compound semiconductors from a gradient in the energy gap. A discussion is given of the dependence of the collection efficiency on the absorption curve of the semiconductor. It is shown that silicon has a very favorable absorption curve in comparison with GaAs or InP. Finally, a treatment is given of the minority carrier collection in a two-junction cell, and calculations are presented for silicon. It is concluded that this structure may be important for cells with high energy gaps and short lifetimes. ***D. A. Kleinman.*** *Bell System Technical Journal*, v. 40, no. 1, Jan. 1961, p. 85-115.

Advanced Radar: Cosmic Noise Limits Long Range Radar. RF radiations from celestial sources may prove to be one of the limiting factors as we try to extend radar ranges. Because they raise the system noise temperature, they reduce the overall sensitivity and must be considered in the design formulation and analysis of long-range radar systems. ***George H. Millman.*** *Space/Aeronautics*, v. 35, no. 1, Jan. 1961, p. 124-129.

Photoconductive Time Constants and Related Characteristics of *p*-Type Gold-Doped Germanium. To measure the very short photoconductive time constants of *p*-type gold-doped germanium, two alternative methods were applied and compared. The first is indirect, using the relationship between the magnitude of generation-recombination noise and carrier lifetimes. The second method is direct, employing a high-speed light-pulsing technique. If no other noise sources are important, the results of the indirect method approach those of the direct method as a lower limit. A combination of such time-constant measurements was performed on a series of crystals in which impurity densities and carrier concentrations had been evaluated by Hall coefficient and conductivity measurements. From these data quantum yields of carrier generation, and cross sections for photon capture and carrier recombination were evaluated. The photon capture cross section of the 0.15 ev gold acceptor level at 5μ is 1.3×10^{-16}cm^2, averaging 0.9×10^{-16}cm^2 for 2-9μ. The hole capture cross section by the Au^- ion in germanium was found to be 2.3×10^{-14}cm^2. ***T. P. Vogl, J. R. Hansen, and M. Garbuny.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 70-75.

* **A Cryostat for Electrical Measurements on Semiconductors.** The cryostat described is used for routine measurements of the resistivity and Hall coefficient of samples of semiconductors. The design enables the cryostat to be dismantled and assembled in a very short time, so that a different specimen may be measured every day. The difficulties of siphoning liquid helium have been avoided by using the transport Dewar as the experimental Dewar. ***B. V. Rollin, J. R. Mills, and J. P. Russell.*** *Cryogenics*, v. 1, no. 2, Dec. 1960, p. 75-76.

Current-Voltage Characteristics of Forward Biased Long *p-i-n* Structures. The current-voltage characteristics have been observed in several Ge *p-i-n* structures in which the *n* side was biased negative and *p* side positive so as to cause a double injection of electrons and holes into the structure. The middle *i* section was constructed of good quality Ge (approximately 2×10^{13} donors/cm^3) and was many minority carrier diffusion lengths long. The observed *I-V* characteristics display a low-field region in which the current is proportional to the voltage followed by a higher field region in which the current is proportional to the square of the voltage. In the square-law region, the current is a function of the difference, rather than the sum, of the thermal densities of the electrons and holes. These observations lend experimental support to the basic theories of Lampert and Rose regarding volume-controlled

double injection into a semiconductor. ***R. D. Larrabee.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 37-39.

a **Carrier Lifetime in Indium Antimonide.** The recombination of excess electron-hole pairs in indium antimonide has been studied in the temperature range 200 K - 15 K, where it is
. controlled by localized centers. Minority carrier trapping is found in extrinsic *p*-type material. The lifetimes of electrons and holes obtained from photoconductivity and photoelectromagnetic effect data on *n*- and *p*-type samples lead to a model
b for the recombination, consisting of a donor center having two energy levels in the forbidden gap, at 0.055 and 0.12 ev above the valence band. ***R. A. Laff and H. Y. Fan.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 53-62.

. **Theoretical Accuracy of Radar Measurements.** The theoretical rms error in measuring time delay (range) and Doppler frequency (relative velocity) are determined for representative
c radar waveforms, including rectangular-, trapezoidal-, triangular-, and Gaussian-shaped pulses as well as the linear FM pulse compression waveform. The so-called "uncertainty" rela-
. tionship of radar is interpreted in terms of measurement errors and the difference between the radar and the quantum mechanical uncertainty principles is discussed. Mention is also made of the theoretical error involved in measuring the angle of
d arrival with an antenna aperture. ***Merrill I. Skolnik.*** *IRE Transactions on Aeronautical and Navigational Electronics*, v. ANE-7, no. 4, Dec. 1960, p. 123-129. ((TK1 In6.6a Vis.)

. * **High-Resolution Radio Telescope.** Describes the "crossed-grating interferometer", a decimeter-wavelength radio telescope with a pencil-beam response sufficiently narrow to provide, in a
e rapid and unambiguous fashion, the data for constructing detailed 'radio pictures' of the sun. ***W. N. Christiansen, N. R. Labrum, K. R. McAlister, and D. S. Mathewson.*** *Institution of Electrical Engineers, Journal*, v. 7, no. 73, Jan. 1961, p.
. 32-34.

Determination of the Required Number of Randomly Spaced Communication Satellites. An investigation for deter-
f mining the minimum number of passive satellites required to provide given percentages of communication time between any two ground stations is presented along with a sample applica-
. tion. The study is limited to the geometrical and probability aspects of the problem. The sample application is for an assumed transatlantic communication link. The satellites are considered to be in circular, randomly spaced orbits with fixed
g inclination angles and altitudes. The altitudes considered range from 1000-5000 statute miles. ***Floyd V. Bennett, Thomas L. Coleman, and John C. Houbolt.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-619*, Jan. 1961, 29 pp. (TL570 Un3t Room 290)
.

Designing Low-Noise Antennas. With low-noise receivers for tropospheric scatter and space communication, a new ap-
h proach is needed to reduce antenna noise .***R. Caldecott and W. H. Peake.*** *Electronics*, v. 34, no. 3, Jan. 20, 1961, p. 60-63.

. * **Elements of Electronic Circuits. XXI. Differentiation and Integration. *J. M. Peters.*** *Wireless World*, v. 67, Jan. 1961, p. 34.

* **Transistor Inverter.** Describes a frequency stabilized circuit
i suitable for running a type recorder. ***F. Butler.*** *Wireless World*, v. 67, Jan. 1961, p. 17-20.

. * **Beam Indexing Tubes. I. An Alternative to the Shadow-Mask Principle for Colour Television Displays.** The de-
j ficiencies of the shadow-mask color display tube are outlined and proposals are made for the design of a tube which is completely free from these deficiencies. It is shown that the N.T.S.C. type of color television signal is not suitable for direct application to the new tube and means are described for transforming the N.T.S.C. signal into a suitable form. The problems
. of synchronizing the color signal with the instantaneous beam position are discussed and various solutions are suggested. ***Ian Macwhirter.*** *Wireless World*, v. 67, Jan. 1961, p. 2-7.

k **Precisely Aligning Doppler Radar Antennas.** Doppler radar for the B-58 Hustler bomber determines velocity to within 0.1%. To obtain this precision, the plane's radar antennas are aligned to within 0.01 degree in the ground installation de-

scribed. ***J. Frank Lane.*** *Electronics*, v. 34, no. 4, Jan. 27, 1961, p. 46-48.

* **A British Communication Satellite.** Requirements, launching and orbital characteristics, and satellite design features. *Spaceflight*, v. 3, no. 1, Jan. 1961, p. 2-4.

Medical Electronics. I. Diagnostic Measurements. Instruments and techniques used to translate physiological parameter into diagnostically significant form are outlined. ***William E. Bushor.*** *Electronics*, v. 34, no. 3, Jan. 20, 1961, p. 49-55.

* **Malvern 45ft Radio Telescope.** Describe construction of the telescope completed at the Royal Radar Establishment, Malvern, in 1957, and applications at centimetric wave-lengths to radio astronomy and Earth-satellite observations. ***J. S. Hey and V. A. Hughes.*** *Institute of Electrical Engineers, Journal*, v. 7, no. 73, Jan. 1961, p. 7-11.

Microphony in Electron Tubes. Theoretical and experimental investigations have shown what can be done in the design and construction of a tube to minimize microphonic effects. ***S. S. Dagpunar, E. G. Meerburg, and A. Stecker.*** *Phillips Technical Review*, v. 22, no. 3, 1960-1961, p. 71-88.

* **Alloy-Diffused Transistors.** Shows why the conventional method of manufacturing alloy junction transistors is incapable of further exploitation at v.h.f. and the method of making the alloy-diffused transistor is given together with the reasons for its advantages. The performance of existing alloy-diffused transistors is described in a number of typical circuits. The future range of alloy-diffused transistors is discussed and it is concluded that when the range is fully established it will be possible to replace thermionic valves for most purposes with the exception of ultrahigh frequency work and power transmitting. ***E. Wolfendale.*** *Electronic Engineering*, v. 33, Feb. 1961, p. 88-93.

* **Methods of Analysis of Circuit Transient Performance.** Some numerical methods applicable in obtaining the distribution of performance parameters associated with the transient behavior of switching circuits are surveyed. The methods considered are: Monte Carlo, parameter sensitivity methods, and a surface fitting method. Each method is used to determine the delay time of a simple system. Their merits and drawbacks are compared and discussed, and estimates are given of the IBM 704 machine time necessary for implementation on a ten-transistor switching circuit. ***L. Hellerman and E. J. Skiko.*** *IBM Journal of Research and Development*, v. 5, no. 1, Jan. 1961, p. 33-43.

Designing Tunnel Diode Oscillators. Tunnel diode relaxation oscillators are analyzed and the circuits for frequency-stabilized sinusoidal and square-wave generators are derived. Push-pull as well as cascade oscillator circuit design raises output power levels. ***Wen-Hsiung Ko.*** *Electronics*, v. 34, no. 6, Feb. 10, 1961, p. 68-72.

New Klystron Design for Constant Repeller Voltage. Usable power at constant repeller voltage over a 10% band is available from klystron with movable grid. Design principle requires careful choice of tube dimensions but can be used over the complete klystron frequency range. ***P. M. Lally and L. Sandstrom.*** *Electronics*, v. 34, no. 6, Feb. 10, 1961, p. 66-67.

Automatic Beacon Radar Identifies Aircraft. Describes an air traffic control beacon system being used by the Federal Aviation Agency for aircraft identification, and expandable to the eventual goal: automatic air traffic control. ***W. L. Woodson.*** *Electronics*, v. 34, no. 6, Feb. 10, 1961, p. 57-61.

* **Survey of Electronically Scanned Antennas. II.** The intention of this paper has been to acquaint the reader with several varieties of electronic scanning antennas available today. There are undoubtedly many other possible schemes; some, yet to be exploited; some modifications and combinations of those presented here. ***Harold Shnitkin.*** *Microwave Journal*, v. 4, Jan. 1961, p. 57-64.

* **Radio-Frequency Interference in Multi-Channel Telephony F.M. Radio Systems.** An investigation is described of the effect of extraneous radio-frequency interference in frequency-modulation multi-channel radio-telephony transmission systems. The noise power ratio in the output telephony base-

band due to an r.f. interfering signal is derived theoretically, and comparison is made with measured values. When the practical limitations in the method of measurement are taken into account, it is concluded that the theoretical results are valid. Results of general application in the design of radio systems are derived from the theory, and the analogy, under certain circumstances, with interference due to long-delay echo-signals is discussed. ***R. Hamer.*** *Institution of Electrical Engineers, Proceedings*, v. 108, pt. B, no. 37, Jan. 1961, p. 75-89.

* **The Crossed-Grating Interferometer: A New High-Resolution Radio Telescope.** A radio telescope has been constructed with sufficient directivity for the production of detailed "radio pictures" of the brightness distribution on the solar disc at decimeter wavelengths. The design and construction of the instrument are described in detail. Concludes with an account of the techniques used in testing and adjusting the arrays. ***W. N. Christiansen, N. R. Labrum, K. R. McAlister, and D. S. Mathewson.*** *Institution of Electrical Engineers, Proceedings*, v. 108, pt. B, no. 37, Jan. 1961, p. 48-58.

* **Solid-State Optical Maser Using Divalent Samarium in Calcium Fluoride.** A new solid-state optical maser with an output frequency in the red portion of the visible spectrum is discussed. One of the important features of this maser is its potential for cw operation. ***P. P. Sorokin and M. J. Stevenson.*** *IBM Journal of Research and Development*, v. 5, no. 1, Jan. 1961, p. 56-58.

* **Periodic Solutions of the Wave Equation With a Nonlinear Interface Condition.** The problem of the voltage oscillations in a transmission line when a diode represented as a nonlinear capacitance is placed in shunt in that line is considered. By an application of Gauss' theorem, the problem is reduced to a nonlinear difference-differential equation. In the case that the generator driving the line is matched to it, this family of equations reduces to a family of nonlinear differential equations. The paper is concerned with a study of the periodic solutions of two classes of equations. ***W. L. Miranker.*** *IBM Journal of Research and Development*, v. 5, no. 1, Jan. 1961, p. 2-24.

A Very Low Frequency (VLF) Synchronizing System. A receiving system for the use of standard-frequency Navy and NBS VLF transmissions to phase-control a local frequency standard has been designed, built, and tested. ***Chesley B. Looney, Jr.*** *I.R.E. Proceedings*, v. 49, Feb. 1961, p. 448-452.

Some Technical Aspects of Microwave Radiation Hazards. Reviews the history of the recognition of the potential hazard and the safety measures adopted by the Bell System and others to protect personnel. Some typical and pertinent research work is discussed, and it is shown how these results have influenced the establishment of criteria for safe and potentially hazardous environments for human beings. Some of the commercially available power-density meters are mentioned, and their method of operation is described. Their use in surveying a site is discussed, and the shielding effect of wire-mesh fences is presented in a nomograph. ***W. W. Mumford.*** *I.R.E. Proceedings*, v. 49, Feb. 1961, p. 427-447.

Understanding Silicon Photocells. Silicon photocells offer a number of advantages in data processing equipment and for low-light-level sensing operations. However, for various reasons design engineers are often uncertain about how to use these devices. Here the photocell characteristics are analyzed and explained. ***Werner Luft.*** *Electronic Industries*, v. 20, Feb. 1961, p. 102-105.

S-Plane Aids Filter Design. The complex frequency plane, better known as the S-plane, plays an important role in modern circuit theory and related fields. This article shows the usefulness of this aid in designing single-tuned filters. ***John J. Jones.*** *Electronic Industries*, v. 20, Feb. 1961, p. 98-101.

Designing 2-Millimeter Wave Components. Lack of a self-excited coherent source of millimeter power has led to the design of crystal harmonic generators. Sufficient signal has been obtained for construction and calibration of several components. Novel design and construction techniques are described here which overcome restrictions of TE_{10} rectangular waveguide. ***Lester L. Bertan.*** *Electronic Industries*, v. 20, Feb. 1961, p. 90-94.

The Tunnel Diode as a Pulse Generator. This article synthesizes a pulse generator which exploits the device's ability to switch more rapidly through the peak, rather than valley, current region. ***Paul Mauch.*** *Electronic Industries*, v. 20, Feb. 1961, p. 106-107.

ENGINEERING ECONOMICS

* **Canada's Regional Markets. III. Here Are the Facts on Motor Vehicles.** Statistical facts on registrations and sales of motor vehicles by regions in Canada. ***N. K. Dhalla.*** *Canadian Business*, v. 34, Jan. 1961, p. 53-60.

Use Break-Even Data to Help Make Decisions. Should you reduce prices? Sell equipment? Cut your staff? Or should you expand? Add new machines? Revise your product mix? These and other similar questions can be answered by using the methods described in this special supplement. ***Spencer A. Tucker.*** *Ceramic Age*, v. 77, no. 1, Jan. 1961, p. 57-65.

Can You Use More Capital? Here is an outline of a program which you may find useful in financing plant modernization and improvement. ***Robert B. Scott.*** *Ceramic Age*, v. 77, no. 1, Jan. 1961, p. 54-56.

* **Cost Engineering in the Process Industries.** Gives methods, specific data, and essential principles for estimating plant, equipment, and operating costs, for predicting both expected earnings and required capital investment, and for making management decisions at the best possible profit. ***Cecil H. Chilton, editor.*** 475 pp. 1960. McGraw-Hill, New York. (TP155 C43c Over.)

Economic Atlas of the Soviet Union. This is the first work outside the Iron Curtain to deal with the Soviet Union as an economic structure of several regions. It is also the first to reflect the marked movement toward decentralization in the Soviet economy. Contains over 60 maps, each with descriptive text, that provide a detailed picture of Soviet farming, mining, industry, and transportation. ***George Kish.*** 93 pp. University of Michigan Press, Ann Arbor, Mich. (G2110 K64e)

* **Future Economic Levels.** Outlines a managerial strategy based on maintaining the strength of the domestic economy while meeting foreign competition, stimulating international trade, and expanding overseas operations. ***Ralph J. Cordiner.*** *Tooling & Production*, v. 26, no. 11, Feb. 1961, p. 8 + 3 pages.

* **Towards Less Protection for Industry.** Deliberations of GATT are always of vital concern to British industry, but its current meeting is made more crucial by the group interests of the European Economic Community and of the Free Trade Association. ***Richard Bailey.*** *Engineering*, v. 190, Dec. 23, 1960, p. 852.

Water Brings Backward Lands to Life. Discusses the development of water resources, chiefly in India, Iran, and Nigeria. ***A. N. M. Robertson.*** *Engineering*, v. 191, Jan. 13, 1961, p. 54-55.

* **Trouble Shooter Tells: The Ups and Downs of Subcontracting From Japan.** A production manager's investigation of Japanese factories and methods. ***Willis A. Bussard and Fred Schlissel.*** *Factory*, v. 119, Feb. 1961, p. 84-89.

* **Big Dams, Big Ditches and Wells Point Way to Pakistan's Growth.** Foreign engineers are aiding Pakistan in utilizing the waters of the Indus River and its tributaries, and in otherwise improving the national economy. ***Waldo G. Bowman.*** *Engineering News-Record*, v. 166, no. 6, Feb. 9, 1961, p. 30 + 3 pages.

* **13 Ways to Update Your PM Program.** Pointers to help you update your basic preventive maintenance activities and wring out even bigger profits than you now enjoy. ***A. F. De Long.*** *Factory*, v. 119, Feb. 1961, p. 66-69.

FLUID MECHANICS

a

Instability of Flow Between Parallel Planes With a Coplanar Magnetic Field. The equations determining the growth of three-dimensional disturbances in the presence of a coplanar magnetic field, which is not parallel to the flow, are shown to be similar to those which determine the growth of two-dimensional disturbances when the field is parallel to the flow. When the field is not parallel to the flow the critical Reynolds number for the flow is shown to be finite for disturbances propagated in a certain direction. A consequence of this result is that the analog of Squire's theorem does not hold, in general, when the magnetic field is not in the flow direction. ***P. T. Wooler.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 24-27.

b

Self-Induced Velocity on a Curved Vortex. By means of examples the distribution of self-induced velocity along a curved vortex is investigated analytically as well as by means of an analog experiment of the magnetic field of a current-carrying cable. Results verify, at least for these examples, a theorem which was intuitively introduced by Hama in his study of detailed process of boundary-layer transition; the induced velocity on a curved vortex is largest in the region where the curvature is largest. ***Francis R. Hama and John Nutant.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 28-32.

c

Motion of a Viscous Liquid Past an Ellipsoid. A symmetrical flow pattern due to the motion of a viscous liquid past an ellipsoidal body is determined. A unitary treatment of the flow problem is possible in which the pure potential flow, the slow viscous flow and the type of flow postulated in the Prandtl theory are seen to be limiting cases of an exact solution. The flow pattern for the case of the sphere and of the elliptic cylinder have been derived as special cases. The method consists in extending the equations of hydrodynamics by the introduction of certain fictitious body forces which are eventually made to vanish in the limit. ***H. G. Venkates.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 33-39.

d

Liquid Distribution in Grid Packings. III. The Effect of Liquid Properties. Changes in the surface tension and viscosity of the irrigating liquid have an insignificant effect on the lateral spread at each touching point in a grid packing compared with the effect of changes in the thickness and pitch of the slats. The liquid properties, however, have a considerable influence on the point-feed rates at which the liquid spread achieves a constant maximum value, i.e., the critical liquid rate L_{crit}, and the liquid spills over the top edges of the slat in between two cross slats, i.e., the spill-over rate L_s. A comparison is made between known values of the minimum effective liquid rate (M.E.L.R.) for grid packed towers and values of the critical liquid rate (C.L.R.) and the critical wetting rate (C.W.R.) calculated from values of L_{crit} and L_s respectively. ***J. W. Mullin and W. M. Butt.*** *Institution of Chemical Engineers, Transactions*, v. 38, no. 6, 1960, p. 308-316.

e

The Hydrodynamics of Liquid Films Flowing on a Vertical Surface. The hydrodynamic theory of thin films put forward by Kapitsa is explained and extended so that the Reynolds number at wave inception and the surface enlargement due to rippling can be calculated. Experimental work supports Kapitsa's theory. ***S. R. Tailby and S. Portalski.*** *Institution of Chemical Engineers, Transactions*, v. 38, no. 6, 1960, p. 324-330.

f

High-Speed Viscous Corner Flow. A boundary-layer integral method analysis is set up for compressible laminar flow in a symmetric corner with varying angle and streamwise pressure gradient. It represents an extension and modification of the constant density analysis of Loitsianskii and Bolshakov. The analysis is applied to the case of constant pressure, constant corner angle, and isothermal surfaces, for which the Crocco velocity-enthalpy relation holds. ***Martin H. Bloom and Stanley Rubin.*** *Journal of the Aero/Space Sciences*, v. 28, Feb. 1961, p. 145-157.

g

Plasma Flow Over a Thin Charged Conductor. The flow of a dense plasma over a wavy conducting wall of small amplitude is investigated where magnetic effects are negligible. These results are then used to analyze the flow over a thin conductor with cusped edges. It is found that the Coulomb drag

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vanishes identically, while the fluid-pressure drag corresponds to the Ackeret value for a neutral particle gas at the reduced-plasma Mach number. ***Hideo Yoshihara.*** *Journal of the Aero/Space Sciences*, v. 28, Feb. 1961, p. 141 + 4 pages.

Dissociation Effects Upon Compressible Turbulent Boundary Layer Skin Friction and Heat Transfer. A sublayer-turbulent layer model is assumed in order to obtain the heat transfer coefficient to skin friction coefficient ratio for Lewis number not equal to one. The conditions under which dissociation equilibrium concentrations apply, on one hand, or diffusion controlled concentrations apply, on the other hand, are examined, and it is shown that the use of diffusion controlled concentrations are quite appropriate for calculating skin friction coefficient for most cases of interest. The diffusion controlled concentration profile is then used in combination with the energy and state equations and the Kármán momentum integral to obtain skin friction coefficients for a flat plate. Curves of local skin friction coefficient are presented for local Mach numbers from zero to four, and degrees of dissociation at the surface or in the external stream of from zero to complete dissociation. The equations for calculating local heat transfer rates are given. ***William H. Dorrance.*** *ARS Journal*, v. 31, Jan. 1961, p. 61-70.

FOOD TECHNOLOGY

* **Time-Temperature Relationships of Custards Made With Whole Egg Solids.** The highest final temperatures were achieved in the custards made with a low-egg formula, and at shallow depth. Bread and rice puddings required more heating than plain custards. Less liquid was drained from the custards made with a high-egg formula. ***Karla Longrée, Martha Jooste, and James C. White.*** *American Dietetic Association, Journal*, v. 38, Feb. 1961, p. 147-151.

Use of *Salmonellae* Antagonists in Fermenting Egg White. I. Microbial Antagonists of *Salmonellae*. Reid S. Flippin and M. N. Mickelson. *Applied Microbiology*, v. 8, no. 6, Nov. 1960, p. 366-370.

Effect of Antibiotic and Chemical Dips on the Microflora of Packaged Salad Mix. Oxytetracycline and Biostat were effective in decreasing the microbial population of fresh vegetables and in maintaining the low counts for 1 week. Citric acid and tartaric acid were effective in lowering counts, but their inhibitory action was not as prolonged as that of the antibiotics. ***Jennie E. Shapiro and Ian A. Holder.*** *Applied Microbiology*, v. 8, no. 6, Nov. 1960, p. 341-345.

* **Pilot Plant Studies on Parboiling of Rice. I. Soaking and Gelatinization. II. Dehydration. III. Effect of Hot Soaking and Mechanical Drying on the Nutritive Value of Parboiled Rice.** The object of the present investigation was to develop controlled, quick and mechanized methods for soaking, gelatinization and drying of paddy so as to produce good quality parboiled rice acceptable to consumers in the East. ***A. C. Mazumder, A. N. Bose, N. C. Ganguli, and B. C. Guha.*** *Journal of Biochemical and Microbiological Technology and Engineering*, v. 2, no. 4, Dec. 1960, p. 431-451.

FUELS AND COMBUSTION

Supersonic Burning Probed; May Bring New Type Missile. *Missiles and Rockets*, v. 8, no. 2, Jan. 9, 1961, p. 33.

Saturn Designers Tackle Advanced Cryogenic Propellants. Oxygen industry's experience is applied to liquid H. ***B. L. Brown and W. B. Smith.*** *Space/Aeronautics*, v. 35, no. 1, Jan. 1961, p. 58-61.

* **Liquid Propellant Review. II.** Considers the "workhorse" propellant systems. ***Alfred J. Zaehringer.*** *Missile Design & Development*, v. 6, Dec. 1960, p. 32 + 3 pages.

* **Army Propellant Research.** ***Ralph Swann.*** *Armed Forces Chemical Journal*, v. 14, no. 6, Nov.-Dec. 1960, p. 2-4.

* **Getting the Best Out of Coal.** C.E.A. conference discusses coal quality, plant operations, and future fuel developments. *Fuel Efficiency*, v. 8, Dec. 1960, p. 47 + 3 pages.

* **Some Practical Considerations for the Application of Coal Pulverization at Coke Plants. *J. W. Leonard and J. D. Clendenin.*** *Blast Furnace and Steel Plant*, v. 49, Jan. 1961, p. 45-48.

* **Coal Winning and Control.** Entails research into ways of solving old difficulties, and an original approach to such new problems as the automatic and remote control of machines, and methods of supporting strata. *Control*, v. 4, no. 31, Jan. 1961, p. 99-101.

* **The Volatile Contents of Coal and the Aromaticity of Its Structure.** Performs a valuation, as well as a basis of theoretical computations, as on a partial experimental one, of the correlation between the indexes of aromaticity for coals computed from the volatile contents and those appointed by the graph-densimetry method and by infrared absorption at 3030 and 2920 cm^{-1}. (*In Polish.*) Zawartość części lotnych w węglu kamiennym a aromatyczność jego struktury. ***Leszek Czuchajowski.*** *Archiwum Górnictwa*, v. 5, no. 3, 1960, p. 241-269.

* **Tertiary Butyl Acetate, an Agent for the Improvement of the Antiknock Property of Lead-Containing Gasoline.** Surveys methods currently used in industry to increase the octane index of gasoline. Gives results from using tertiary butyl esters in very small amounts in fully leaded high octane index gasolines. (*In French.*) L'acétate de butyle tertiaire, agent d'amélioration du pouvoir antidétonant des essences au plomb. ***R. S. Aries.*** *Institut Français du Pétrole, Revue et Annales des Combustibles Liquides*, v. 15, Dec. 1960, p. 1881-1885.

* **POL Logistics Readied for Future Battlefields.** A look at the new military fuel depot. Logistics are considered. ***Paul B. Tonks.*** *Petroleum Engineer*, v. 33, Jan. 1961, p. E2-E4.

* **A Practical Approach to Fuel Economy.** Reasons for economy include reducing costs of production of goods or services, conserving natural resources, and reducing atmospheric pollution. Reports recent work in the field. ***J. M. Austin.*** *Australasian Engineer*, v. 52, Nov. 1960, p. 67-74.

* **Three Steps Towards Good Combustion.** Developments in oil burner design. *Engineering*, v. 190, Dec. 23, 1960, p. 874.

* **A Short History of Pulverized-Fuel Firing. *R. H. Essenhigh.*** *Institute of Fuel, Journal*, v. 34, Jan. 1961, p. 16-26.

Boron Hydride Derivatives. IV. Friedel-Crafts Methylation of Decarborane. V. Nucleophilic Substitution in Decaborane. VI. Decaborane Grignard Reagent. IV. ***R. L. Williams, I. Dunstan, and N. J. Blay.*** V. ***I. Dunstan, R. L. Williams, and N. J. Blay.*** VI. ***I. Dunstan, N. J. Blay, and R. L. Williams.*** *Chemical Society, Journal*, 1960, Dec., p. 5006-5019.

* **The Effect of Operating Conditions on the Performance of Different Types of Oil Burners.** Tests carried out to assess the performance of five different types of oil burners. ***L. E. Reed and S. C. Wallin.*** *Institute of Fuel, Journal*, v. 34, Jan. 1961, p. 26-36.

* **Tail Gas Reforming in England.** Describes the first large-scale reformer based on noncontinuous conversion of refinery tail gas over nickel catalyst. ***M. Swiss.*** *Mining & Chemical Engineering Review*, v. 53, no. 3, Dec. 15, 1960, p. 56-59.

Studies of Knock and Antiknock by Kinetic Spectroscopy. II. Shows that lead tetraethyl markedly increases the autoignition delay in explosions of O with *n*-heptane or *iso*-octane, using various sensitizers. During the induction periods of explosions containing Pb, the gaseous PbO band system occurred strongly, but there were no indications of the separation of a solid phase. ***K. H. L. Erhard and R. G. W. Norrish.*** *Royal Society, Proceedings*, v. 259, ser. A, Dec. 29, 1960, p. 297-303.

Suppression of Pulsations in Oil-Fired Residential Heating Equipment. Summarizes and discusses techniques for suppression. Techniques are divided into two main categories—those used to combat changes affecting the acoustic pressure oscillations and those used to combat changes affecting periodic

heat release. ***C. F. Speich and A. A. Putnam.*** *ASHRAE Journal*, v. 3, Jan. 1961, p. 49 + 7 pages.

Hydrogen Promising for Space Unit Secondary Power. Hydrogen characteristics are best suited for integrating power generation with environmental control. ***D. K. Breaux, W. L. Burriss, and R. L. Schultz.*** *SAE Journal*, v. 69, Feb. 1961, p. 82-84.

* **The Composition of a Lurgi Brown Coal Tar.** Neutral oil fraction N/I was found to contain aromatics (78 wt %), olefins (10%), paraffins (5%), and non-hydrocarbons (7%); neutral oil fraction N/II contained aromatics (67%), olefins (15%), paraffins (7%), and non-hydrocarbons (11%). The aromatics were mostly benzenes with short side chains, the olefins chiefly straight-chain α-olefins, and the paraffins were mainly n-alkanes. The non-hydrocarbons were mainly methyl-n-alkyl ketones and furans with some thiophenes. ***I. Brown.*** *Australian Journal of Applied Science*, v. 2, no. 4, Dec. 1960, p. 403-433.

The Role of Fluidity in Coal Carbonization. Investigates influence of the maximum fluidity attained by the charge on physical quality of the coke or char produced. ***G. H. Martindill and M. J. Kovalik.*** *U. S. Bureau of Mines Report of Investigations* 5699, 1960, 23 pp. (TN21 Un3r Room 290)

Solid Propellants. Advantages and problems when used with ground-to-air, rapid-firing missile systems. ***Michael Voytish, Jr.*** *SAE Journal*, v. 69, Feb. 1961, p. 46-48.

Laboratory-Scale Gasification of Coal-Water Slurries in a Metallic Tube Coil. The technical feasibility of gasifying powdered, noncoking, low-rank coal with steam in an externally heated tube has been demonstrated. The tube, 112 ft. of alloy-steel tubing shaped into a helix, served as an electrical conductor of electricity used for heating. ***J. L. Konchesky, R. F. Stewart, and J. J. S. Sebastian.*** *U. S. Bureau of Mines Report of Investigations* 5704, 1960, 29 pp. (TN21 Un3r Room 290)

* **Producing Pure Hydrogen From Dissociated Ammonia.** Produced by low-temperature condensation of N in the mixture followed by low-temperature adsorption of the residual N to give a product containing less than 100 ppm N impurity. *British Chemical Engineering*, v. 6, Feb. 1961, p. 106.

GEOLOGY, GEOPHYSICS, MINERALOGY, AND MINING ENGINEERING

* **Recent Research in Arctic Meteorology.** A short history of arctic meteorology and descriptions of recent research. The importance of meteorological research and planning in arctic transportation is discussed. ***S. Orvig.*** *Canadian Aeronautical Journal*, v. 7, no. 1, Jan. 1961, p. 19-23.

Seismology Takes to Undersea Warfare. Oil-hunting techniques as applied to identifying, targeting enemy submarines; beacon built for ocean-bottom Polaris navigation. ***Hal Gettings.*** *Missiles and Rockets*, v. 8, no. 2, Jan. 9, 1961, p. 28-29.

Gas and Oil Segregation in Oilfield Reservoirs. In the exploitation of crude petroleum reservoirs, segregation may have pronounced effects upon primary recovery, particularly in the types of reservoirs in which gas initially in solution in the reservoir liquids provides the dominant expulsion mechanism by gas liberation and expansion. Gross analytical description of the history of expanding gas caps has been attempted in the literature, but analytical evaluation of cumulative gas migration from the oil zone to gas cap is avoided and the migration considered as a fraction of produced gas. Offers analytical expressions for instantaneous rate of segregation. ***H. Gilmour.*** *Institute of Petroleum, Journal*, v. 46, Dec. 1960, p. 383-390.

* **A Special Report on North Africa.** One of the world's most desolate regions has become a major oil and gas producer. *World Oil*, v. 152, Jan. 1961, p. 61-84.

Alluvial Prospecting and Mining. New sections have been added for forward preparation of overburden, miscellaneous methods of mining, and selection of equipment. ***S. V. Griffith.*** 2nd Rev. Ed. 245 pp. 1960. Pergamon Press, New York. (TN270 G87a2)

a * **On Indirect Temperature Soundings of the Stratosphere From Satellites.** Outgoing radiation from the atmosphere is calculated at several frequencies in the 15-μ CO_2 band according to the random Elsasser band model and the Curtis-Godson approximation to the mean line width. ***D. Q. Wark.*** *Journal of Geophysical Research*, v. 66, no. 1, Jan. 1961, p. 77-82.

b * **Probing the Earth With Nuclear Explosions.** Emphasizes the usefulness of past nuclear weapon tests in determining the internal structure of the earth. Shot times and locations are tabulated for 169 U. S. atomic explosions, with seismic data from Pasadena. ***D. T. Griggs and Frank Press.*** *Journal of Geophysical Research*, v. 66, no. 1, Jan. 1961, p. 237-258.

c * **The Effects of Folding Upon the Orientation of Sedimentation Structures.** The primary orientation of sedimentation structures in folded regions is often considerably modified as a result of flexure, shear, and compression during the production of the folds. The effects of these various deformation processes are described and techniques are suggested by which the initial orientation of the structures can be established. ***John G. Ramsay.*** *Journal of Geology*, v. 69, no. 1, Jan. 1961, p. 84-100.

d * **Acoustic Logging.** Reviews present knowledge about acoustic measurements in bore-holes. Principles and various tools are considered; limitations and corrections are noted and explained. (*In French.*) Les diagraphies acoustiques. ***F. Lebreton and J. Arnaud.*** *Institut Français du Pétrole, Revue et Annales des Combustibles Liquides*, v. 15, Dec. 1960, p. 1813-1846.

e * **Plotting of Water Current Patterns by Photogrammetry.** ***W. D. Forrester.*** *Photogrammetric Engineering*, v. 26, no. 5, Dec. 1960, p. 726-736.

* **Very Accurate Correction of Aerial Photographs for the Effects of Atmospheric Refraction and Earth's Curvature.** An equation which is accurate to within 0.02% of the distance from the nadir for angles as high as 10° below the horizon and altitudes as great as 500 miles. ***Cran H. Barrow.*** *Photogrammetric Engineering*, v. 26, no. 5, Dec. 1960, p. 798-804.

f **What Will Man Find on the Moon?** Results from a discussion. ***Nigel Calder.*** *New Scientist*, v. 8, Dec. 22, 1960, p. 1636-1638.

* **Meteorites.** ***Glenn I. Huss.*** *Mines Magazine*, v. 51, Jan. 1961, p. 21 + 3 pages.

g * **Analysis and Comparison of Five Methods Used to Predict Water Flood Reserves and Performance.** Methods used to predict reserves and their performance. All assumptions involved are presented and discussed along with the necessary equations. Both theoretical and empirical concepts were considered in the study. ***R. C. Earlougher and E. T. Guerrero.*** *Mines Magazine*, v. 51, Jan. 1961, p. 11-20.

h * **Theory of Particle Arches.** Establishes the fundamentals of particle arches and the statics of particles in containers of circular cross-section. ***Vedat Aytaman.*** *Canadian Mining Journal*, v. 82, Jan. 1961, p. 41-45.

* **Massive 15-Ft. Drill Bit Gets Trial Run.** Bit is being tested toward adaptation of oil well equipment to large-diameter drilling. *Petroleum Week*, v. 12, no. 3, Jan. 20, 1961, p. 33-34.

i * **The Basic Variables in Rotary Drilling.** Basic relationships in light of extensive research studies of the process. ***B. G. Fish.*** *Mine & Quarry Engineering*, v. 27, Jan. 1961, p. 29-34.

j * **The Unique Meteorite Crater at Dalgaranga, Western Australia.** Scientific examination of the crater has revealed specimens exhibiting a variety of structures and compositions hitherto unknown in connection with any meteorite crater. ***H. H. Nininger and Glenn I. Huss.*** *Mineralogical Magazine and Journal of the Mineralogical Society*, v. 32, Dec. 1960, p. 619-639.

* **Petroleum Technology.** Annual survey with 546 references. (*In German.*) Erdöltechnik. ***Josef Moos.*** *VDI Zeitschrift*, v. 103, no. 1, Jan. 1, 1961, p. 29-42.

k * **Calculation of the Dispersion of the Long Period Love Waves on the Earth's Surface.** The dispersion on a spherical surface is obtained by a numerical integration of the differential equation of motion. For the fundamental mode, the group ve-

locities obtained for periods from one to a few minutes are of the same order as the velocities observed for G waves. The effect of a low-velocity layer at a depth of 150 km is a weak inverse dispersion for the fundamental mode when the crust is oceanic. (*In French.*) Calcul de la dispersion des ondes de Love grande période a la surface de la terre. ***N. Jobert.*** *Annales de Géophysique*, v. 16, no. 3, July-Sept. 1960, p. 393-413.

Mining Practice—Better Techniques From Better Equipment. Important developments of the last few years are reviewed. ***Bernard R. Henderson.*** *Engineering and Mining Journal*, v. 162, Jan. 1961, p. 88-95.

* **Introduction to the Motions of the Moon.** Engineers must concern themselves with the complex motions of the moon and earth in relation to the sun. The language used to describe these motions, heretofore the property of the astronomer and astrophysicist, is offered in this paper to the engineer. ***Joseph P. Duda.*** *Sperry Engineering Review*, v. 13, no. 4, Dec. 1960, p. 19-25.

* **Craters of the Moon.** Volcanic, meteoric, and plutonic theories are discussed. ***John W. Macvey.*** *Spaceflight*, v. 3, no. 1, Jan. 1961, p. 13-15.

* **Some Results of Fracturing With the Single-Point Entry Technique.** Results indicate that fracturing treatments can be performed more easily through the single entry than through perforations, and the production histories available thus far indicate that wells fractured with the single-point entry technique have higher productivities than those fractured by conventional wellbore preparation. ***V. N. Swift, J. W. Jennings, W. E. Bauman, and J. L. Huitt.*** *Journal of Petroleum Technology*, v. 13, Jan. 1961, p. 29-34.

* **Bureau of Mines Research in Hydraulic Coal Mining.** Results of a field investigation covering such aspects as nozzle size, water pressure and mining method. ***J. J. Wallace.*** *Mining Congress Journal*, v. 47, Jan. 1961, p. 52-54.

* **Fighting Underground Mine Fires With Foam Producing Detergents.** A secondary method of attack that can provide control of fires where direct attack is not effective. ***Bernard W. Carey.*** *Mining Congress Journal*, v. 47, Jan. 1961, p. 40-42.

* **Thorium, Uranium and Zirconium Concentrations in Bauxite.** Samples were analyzed by gamma-ray spectrometric, alpha counting, and wet chemical methods. The Th concentrations range from 5.0 to 131 ppm and average 48.9 ppm. ***J. A. S. Adams and K. A. Richardson.*** *Economic Geology*, v. 55, no. 8, Dec. 1960, p. 1653-1675.

* **Evaluation of Available (Water) Supplies in the Western United States, in Relation to Desalinization.** ***Samuel B. Morris.*** *American Water Works Association, Journal*, v. 53, Jan. 1961, p. 3-10.

New Sonar Thumper Charts Ocean Subbottom. Force produced by capacitor discharge into encapsulated coil produces movement of an underwater Al plate, generates low-frequency sound pulse at high energy for marine geological surveys. *Electronics*, v. 34, no. 5, Feb. 3, 1961, p. 56-57.

Measurement of the Wear Rate of Cast Grinding Balls Using Radioactive Tracers. Cobalt-60 was used as the tracer, which was added to the molten steel prior to casting. The cast balls were used in a mill at an iron mine. The charge was sampled at weekly intervals to pick out some of the radioactive balls. These balls were inspected and weighed, and the wear rate calculated. ***J. D. Keys and G. G. Eichholz.*** *Canada, Mines Branch, Technical Bulletin TB* 18, June 1960, 14 pp. (TN26 C16.5tb Contin.)

* **Solar Energy for the Indian Village.** ***P. Zealey.*** *Research Applied in Industry*, v. 14, Jan. 1961, p. 36-37.

* **Microseisms.** Microseisms are tiny ground vibrations of amplitude up to 10 and frequency ranging from 0.1 to 0.2 sec^{-1}. Although they are a nuisance to the earthquake seismologist, they can, however, be very useful as a tool in meteorological prediction as they can not only give advance warning of the approach of a storm but also give its direction of approach and the strength of the winds in it. ***J. Darbyshire and B. J. Hinde.*** *Research Applied in Industry*, v. 14, Jan. 1961, p. 8-17.

* **The Spreading of Surface Films From Solutions of Cetyl Alcohol.** ***F. D. Lugton and R. G. Vines.*** *Australian Journal of Applied Science*, v. 2, no. 4, Dec. 1960, p. 497-500 + 3 plates.

Origin of the Pacific Basin: A Meteorite Impact Hypothesis. Attempts to show that an explosion excavated a large crater of several thousand kilometers in radius and some hundreds of kilometers in depth. Great masses of material that were swept back dropped at the rim of the crater to form discontinuities of crustal structure and composition. ***E. R. Harrison.*** *Nature*, v. 188, Dec. 24, 1960, p. 1064-1067.

International Oil and Gas Development. Review of 1959, Pt. I-II. Annual review of geological and geophysical prospecting, oil and gas production by fields, oil and gas pipe-line runs, and many other phases of the industry. ***Harvey E. Boos, Thomas W. Brinkley, and Jack L. Wiggins, editors.*** v. XXX, 832 and 960 pp. Aug. 1960. American Institute of Mining, Metallurgical, and Petroleum Engineers, New York. (TN862 N21o Vis.)

A Study of the Effect and Nature of Seasonal Changes Upon the Heavy Metal Content of Certain Sub-Arctic Streams. Attempts to determine the effect and nature of the year-around seasonal changes upon the soluble heavy metal content of certain streams. ***Leo Mark Anthony and Nalin R. Mukherjee.*** 28 pp. May 1960. The Arctic Institute of North America, College, Alaska. (TN24.A4 AL12.85s Over.)

Soil Stabilization With Asphalt, Portland Cement, Lime and Chemicals. *Highway Research Board, Bulletin* 241, 1960, 126 pp. (TE1 H53b Contin.)

Summary of Rocket and Satellite Observations Related to the Ionosphere. New knowledge relating to the earth's ionosphere in the past three years is reviewed. Measurements of electron densities up to and above the F_2-maximum, columnar electron densities, electron density gradients, sporadic-E and spread-F are discussed. ***J. Carl Seddon.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA-TN-D-667*, Jan. 1961, 22 pp. (TL570 Un3t Room 290)

Well Productivity Related to Drilling Muds: Umiat Field, Naval Petroleum Reserve No. 4, Alaska. An evaluation by the Federal Bureau of Mines of the effect of clay-water, brine, and oil-base drilling fluids on the productivity of 11 test wells drilled on the Umiat anticline in northern Alaska. ***George L. Gates and W. Hodge Caraway.*** *U. S. Bureau of Mines Report of Investigations* 5706, 1960, 21 pp. (TN21 Un3r Room 290)

GRAPHIC ARTS

* **Speedup in Office Copying.** Paper-negative copying, lensless diffusion transfer, thermography, dry, thermo-fax, blueprinting, electrostatic, long distance copying, disappearing confidential messages are described. *Industrial Research*, v. 2, no. 6, Dec. 1960-Jan. 1961, p. 69 + 4 pages.

HEAT POWER

* **Gas Turbines for Cars "Maybe" by 1966.** Billions in tooling will have to be scrapped before new engines get wide usage. But jets could boost metal production shops out of present sales slump. ***Ted Douglas, editor.*** *Canadian Metalworking*, v. 24, Jan. 1961, p. 38-41.

A Review of Turbulent Flame Propagation. In the first part, the flames theories and corresponding flame models are discussed as well as their experimental verification. The second part of the paper is concerned with the most recent developments in turbulent flame theories and a criterion for the flame model, for which some interesting combustion data are presented. ***Louis A. Povinelli.*** *Aerotechnica*, v. 40, no. 5, Oct. 1960, p. 272-283.

* **The Reliability of Multiple Rocket Engines.** In assessing the merits of multiple versus single engines the possibility of a loss in reliability due to the use of more working parts must be considered. Gives a mathematical treatment of this problem and numerical examples illustrate the method. ***Gillian Ruston.*** *Aeronautical Quarterly,* v. 11, pt. 4, Nov. 1960, p. 371-386.

* **Fuel Cells.** Principles, historical background, types, and present applications are discussed. ***R. J. Ruka.*** *Power Engineering,* v. 65, Jan. 1961, p. 67-71.

* **Radial Grids With Water Injection for Suppressing the Noise of Jet Engines.** Jet engine noise suppression by water sprays introduced into the stream of exhaust gases; noise level reduction obtained was 31.5 db. ***H. U. Wisniowski.*** *Canadian Aeronautical Journal,* v. 7, no. 1, Jan. 1961, p. 25-32.

Internal-Performance Evaluation of Two Fixed-Divergent-Shroud Ejectors. Ejectors designed for use in a Mach 2.2 aircraft were evaluated over a range of representative primary pressure ratios and ejector corrected weight-flow ratios. Basic thrust and pumping characteristics are discussed in terms of an assumed engine operating schedule to illustrate the variation of performance with Mach number. The two designs differed about 16% in the shroud longitudinal spacing ratio. For ejector corrected weight-flow ratios up to 0.10, the performance of the fixed-shroud ejector designs is comparable with that of a similar continuously variable ejector except at conditions corresponding to acceleration with afterburning from Mach 0.4 to 1.2. In this region, the ejector thrust ratio decreased to a minimum of 0.96. ***James R. Mihaloew.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-763, Jan. 1961, 30 pp. (TL570 Un3t Room 290)

Internal-Performance Evaluation of a Two-Position Divergent Shroud Ejector. A quiescent-air internal-performance evaluation was conducted on 0.3-scale models of a two-position divergent shroud ejector applicable to operation at flight Mach numbers up to 2.5. The shroud positions corresponded to those used under typical turbojet nonafterburning and afterburning operating conditions. A series of fixed-scale models simulating maximum afterburning takeoff, maximum afterburning acceleration, partial afterburning cruise, and nonafterburning cruise was evaluated. The investigation was conducted with dry unheated air over a range of primary pressure ratios to 23 and ejector corrected weight-flow ratios to 0.10. The ejector thrust ratio was between 0.97 and 0.98 over the entire range of operating conditions except for acceleration with afterburning through the Mach number region from 0.9 to 1.1, where it decreased to as low as 0.945 for an ejector corrected weight-flow ratio of 0.105. ***James R. Mihaloew and Andrew J. Stofan.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-762, Jan. 1961, 19 pp. (TL570 Un3t Room 290)

Experimental Method of Measuring Intensity of Turbulence in a Rocket Chamber. Experimental values of intensity of turbulence in a two-dimensional hydrogen-liquid oxygen rocket engine were determined from the spread of a gas jet diffusing in the combustion chamber. The diffusion was determined photographically, using sodium *d*-line radiation as a flow tracer. The results indicated that the intensity of turbulence is relatively high near the injector but diminished downstream. Changes of several operating parameters had little, if any, effect upon intensity of turbulence. ***Martin Hersch.*** *ARS Journal,* v. 31, Jan. 1961, p. 39-45.

Performance of Plug-Type Rocket Exhaust Nozzles. The physical characteristics of a plug nozzle are described and compared with a conventional converging-diverging nozzle. The mathematical analysis of the aerodynamic performance of a plug nozzle is outlined, including the Prandtl-Meyer corner expansion of the flowing gas. The advantages of the plug nozzle in terms of superior performance at lower than design pressure ratio, smaller physical size and aerodynamic thrust vector control are described. ***K. Berman and F. W. Crimp, Jr.*** *ARS Journal,* v. 31, Jan. 1961, p. 18-23.

Recent Advances in Electric Arc Plasma Generation Technology. ***Richard R. John and William L. Bade.*** *ARS Journal,* v. 31, Jan. 1961, p. 4-17.

Recoverable Air-Breathing Boosters—Analysis of Their Potentialities. Evaluates the potentialities of air-breathing boosters which use the currently best expected air-breathing engine technology in comparison with rockets. ***C. W. Frick and T. Strand.*** *Aero/Space Engineering,* v. 20, Feb. 1961, p. 22 + 6 pages.

Effect of Nozzle Convergence Length on Performance of a Heptane-Oxygen Combustor. The effect of nozzle convergence length on the performance of heptane reacting with gaseous oxygen was evaluated in a nominal 200-pound-thrust uncooled combustor. Varied lengths of the nozzle convergence section between the chamber and throat and various cylindrical-chamber lengths were used to provide different combustor gas velocity profiles. Characteristic velocity as a function of the characteristic length and of the total combustor length was obtained for three lengths of the nozzle convergence section. The study was made with two injectors of different performance characteristics, a single contraction ratio, and one propellant-flow condition. ***Marshall C. Burrows.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-579, Dec. 1960, 22 pp. (TL570 Un3t Vis.)

Simplicity = Success With Able, Ablestar Upper-Stage Vehicles. The able upper-stage vehicle has a regeneratively cooled, Al spaghetti tubing thrust chamber with an exit to throat area ratio of 20/1 which operates on a hypergolic propellant combination of white fuming nitric acid and unsymmetrical dimethylhydrazine. ***W. D. Stinnett, J. S. Robbins, and D. Holzman.*** *SAE Journal,* v. 69, Feb. 1961, p. 74-77.

Saturn Engine Adapted From Missiles. Design features and performance characteristic of booster, originally called the Juno V, and redesignated the SATURN. ***Roy Healy.*** *SAE Journal,* v. 69, Feb. 1961, p. 34-37.

An Ion Rocket With an Electron-Bombardment Ion Source. An ion-rocket engine with a 10-cm-diam. electron-bombardment ion source was investigated. Both theory and experimental results are presented. Mercury ion exhaust beams up to 0.06 amp were obtained with over-all engine power efficiencies of 0.27 to 0.33 at specific impulses from 4500 to 5500 sec. Use of a more efficient field coil to generate the small magnetic field required could increase these values to about 0.40 and 0.45. Further increases in efficiency appear likely from improvement of other components. Propellant-utilization efficiencies were as high as 0.80. An electron-bombardment ion source appears to be one of the most promising for ion rockets. ***Harold R. Kaufman.*** *U. S. National Aeronautics and Space Space Administration, Technical Note, NASA TN*-D-585, Jan. 1961, 38 pp. (TL570 Un3t Room 290)

An Analysis of Thermal Radiation Heat Transfer in a Nuclear-Rocket Nozzle. A calculation procedure was developed for determining the radiant heat flux along a nuclear-rocket nozzle wall. The results of calculations of heat flux are presented for a wide range of nozzle geometries, reactor-face temperatures and emissivities, and nozzle-wall temperatures and emissivities. Since the heat-flux calculations were somewhat laborious, an approximate method for obtaining the radiant-heat-flux distribution for similar nozzles by a relatively simple interpolation procedure was also developed; and reasonably good agreement between the calculation procedure and the interpolation method was obtained. ***William H. Robbins.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-586, Jan. 1961, 24 pp. (TL570 Un3t Vis.)

HUMAN FACTORS

* **Changes in the Positions of the Invariant Colours With the State of Adaptation of the Eye.** The colors which retain their daylight appearances to each of five observers under three cases of chromatic adaptation and one case of white adaptation are determined from binocular matching data. The assumption of the linearity of the relationship between the tristimulus values of the corresponding colors which underlies the analytical treatment of the data is shown to be fulfilled in all the cases, the evidence being the agreement between the observed matches and those computed from the linear transformation. ***Elaine G. T. Wassef and Erone Aziz.*** *Optica Acta,* v. 7, no. 4, Oct. 1960, p. 341-354.

* **The Psychophysical Testing of an Aircraft Visual Approach Aid.** An aircraft visual approach aid, based on the perception of a misalignment between bars of lights on the ground, is described. Psychophysical tests to establish its sensitivity at long range under various viewing conditions are discussed, including tests in the field and in a laboratory simulator. ***R. H. Day, J. R. Baxter, and J. C. Lane.*** *Human Factors*, v. 2, no. 4, Jan. 1961, p. 203-210.

* **Manual Application of Impulses While Tractionless.** The percentage of 20 naïve subjects who, while tractionless in a horizontal plane and anchored by one handhold, push in or pull out a plunger in one motion against various frictional forces and travel distances, decreases directly as the force and distance required. With large-force impulses, the impulse is linear and the situation can be described by the impulse = momentum theorem) $\int_0^t F dt = mv_1 - mv_0$. The shape of the impulse is saw-toothed, and its area approximated by taking three-fourths of the area of a rectangle whose base is the duration, and height, the force of the impulse. For this experiment, the maximum duration of an effective impulse for a required force of 40 lb is 0.5 sec for a push-in, and 0.3 sec for a pull-out impulse. ***Ernest Dzendolet.*** *Human Factors*, v. 2, no. 4, Jan. 1961, p. 221-227.

* **Acceleration and Motor Performance.** Experiments concerning the effects of acceleration on motor performance are discussed in a sequence which illustrates the evolution of research techniques in recent years. In the simplest of these techniques, performance is evaluated during or immediately following exposure to pre-programmed acceleration time histories. A more complex technique involves the study of interaction of subject performance with the pattern of acceleration experienced. Accelerations are actually controlled by subject performance by means of an analog computer control system. Certain limitations of centrifuge simulations are discussed. ***John Lott Brown.*** *Human Factors*, v. 2, no. 4, Jan. 1961, p. 175-185.

* **Extra-Foveal Colour Metrics.** A series of monochromatic equal-brightness stimuli of subtense 40′ x 80′ was established through the spectrum by direct comparison with a neighboring 530 mμ patch of retinal illumination 10.8 photopic trolands. The separated test and comparison fields lay at 10° eccentricity in the nasal meridian, had dark surrounds and were viewed by a flash-and-recovery cycle, using 2 or 30 flashes to establish the matches. These test stimuli were subsequently matched by comparison with a foveal patch consisting of matching stimuli 650 mμ, 530 mμ and 460 mμ, results being plotted as a spectrum locus in the foveal chromaticity chart. Luminous efficiency functions were determined. ***F. J. J. Clarke.*** *Optica Acta*, v. 7, no. 4, Oct. 1960, p. 355-384.

* **Ergonomics or Human Engineering.** Deals with the application to industry of three or four academic disciplines essential in the present and future context of technological development. *Coke and Gas*, v. 23, Jan. 1961, p. 14 + 3 pages.

* **Digital Simulation in Research on Human Communication.** Operating on digitalized speech or pictorial signals, a stored program computer can perform processing equivalent to any coding. The output signals so produced can then be made available for subjective evaluation, thereby removing the necessity for premature instrumentation to produce samples for viewing or listening. ***Edward E. David, Jr.*** *I.R.E. Proceedings*, v. 49, Jan. 1961, p. 319-329.

INFORMATION—PREPARATION AND DISSEMINATION

6 Documentation in Research and Theory. The position of documentation in science and theory is investigated and explained. This young field of research should have a place in the university curriculum and program of studies of technical institutes in Germany. The article was published on the occasion of the 12th Annual Congress of the German Society for Documentation at Würzburg, October 17-21, 1960. (*In German.*) Dokumentation in Forschung und Lehre. ***E. Pietsch.*** *Nachrichten für Dokumentation*, v. 11, no. 4, Dec. 1960, p. 187-192.

* **The Increasing Information Requirements of Enterprises.** Today's increasing mass of information, useful for safe decisions from management, must be reduced to a practical amount for selection and evaluation. Information concerning planning and control are centralized into the hand of a vice-president. The more accurately and intensely the information worker is aware of the problems outside his enterprise and of the criteria ruling the management's decisions, the more important his services will be within the range of the information process. (*In German.*) Der wachsende Informationsbedarf der Unternehmungen. ***Eugen Sieber.*** *Nachrichten für Dokumentation*, v. 11, no. 4, Dec. 1960, p. 175-180.

* **Promoting and Coordinating Documentation and Information Within the Range of the Total Transportation Traffic.** The German Society for Documentation in a meeting of its members on Oct. 18, 1960, decided on the publication of a special review which will serve to coordinate the documentation concerning the total transportation system in Western Germany. This is based on the need for neutral and objective collaboration between research, theory, design, practice and legal investigation in the railroad, and the river, sea and air navigation systems. (*In German.*) Zur Förderung und Koordinierung von Dokumentation und Information im Bereich des gesamten Verkehrswesens. ***Hans Sparkuhle.*** *Nachrichten für Dokumentation*, v. 11, no. 4, Dec. 1960, p. 185-186.

Training Personnel. A private school for training data processing people was set up to fill a need. Here, the author, who now has five such schools in operation, tells how they operate. ***V. J. Bronsing.*** *Data Processing*, v. 3, Jan. 1961, p. 22-23.

* **Direct Input Methods.** Magnetic ink character recognition (MICR) and its future is discussed. ***Joseph R. De Paris.*** *Data Processing*, v. 3, Jan. 1961, p. 26 + 1 page.

* **Optical Scanning Equipment.** Developments in machines that will process information into a computer merely by passing over it. ***John H. DeJong.*** *Data Processing*, v. 3, Jan. 1961, p. 11-12.

* **Optical Character Recognition.** Discusses data processing equipment capable of providing computer input signals directly from documents printed by ordinary business machines, including typewriters, without intervention of a manual key punch operation. Optical character recognition, the process performed by such equipment, is being developed as a means of better communication between the user and computer. ***Weld S. Carter, Jr.*** *Data Processing*, v. 3, Jan. 1961, p. 7-10.

* **How to Find Out-of-Print Publications.** ***Agatha Leonard.*** *Special Libraries*, v. 52, no. 1, Jan. 1961, p. 22-23.

INSTRUMENTATION

* **Techniques for Electron Microscope Studies of Bainitic Steels.** The purpose of the work was to formulate best etching reagents for bainitic steels. Several reagents were tested at constant concentration and varying etching times. The best results were obtained with alcohol solutions of trichloroacetic and nitric acids. Interpretation of the micrographs. (*In Czech.*) Technika badania struktur bainitycznych przy pomocy mikroskopu elektronowego. ***J. Eysymontt.*** *Prace Instytutów Hutniczych*, 1960, no. 12, p. 148-253.

* **Calculation of "Leaky" Vacuum Installations.** Methods of calculating the dimensions of leaky vacuum systems presented in this article include short-cut graphical procedures for estimating the permeabilities of seals, characteristics of vacuum pumps and of the pumping system in the presence of leaks. Also presented is a nomogram for determining the most economical operating conditions. ***A. Roth.*** *British Chemical Engineering*, v. 6, Jan. 1961, p. 40-44.

* **Transistorized Schmitt Trigger Circuit.** The input and output curve families of the Schmitt trigger circuit which is often used for pulse shaping are investigated. The conditions for a partially negative behavior of the input characteristics are calculated. This shape of the characteristics is decisive for pulse shaping. After these investigations, the flip flop circuit is treated

as a feedback Schmitt trigger circuit. (*In German.*) Der Schaltmechanismus des Schmitt-Triggers mit Transistoren. ***K. Leberwurst.*** *Nachrichtentechnik*, v. 10, no. 12, Dec. 1960, p. 519-523.

* **A Double Pulse Generator for Measurements on Transistors.** Deals with a measuring instrument for investigating phenomena of delay in transistors by the double pulse method. Design and operation of the instrument are explained by means of a block diagram and a time diagram. Finally, details concerning the circuits of the individual stages are given, as well as other possibilities for application. (*In German.*) Ein Doppelimpuls-Generator für Messungen an Transistoren. ***M. Richter.*** *Nachrichtentechnik*, v. 10, no. 12, Dec. 1960, p. 524-529.

* **Extension of the Bridge Measuring Method in Order to Determine the Self Capacitances of Induction Coils.** Measuring methods are described and equations are derived for determining the self capacitances of induction coils by measurements with a differential bridge, with a bridged T-bridge, and with a double T-bridge. (*In German.*) Erweiterung des Brückenmessverfahrens zur Bestimmung der Eigenkapazität von Induktionsspulen. ***P. M. Todorov.*** *Nachrichtentechnik*, v. 10, no. 12, Dec. 1960, p. 537-539.

* **A New Rectifier for Industrial HF Heating Eqnipment.** Deals with a rectifier which has been made up of assembly units only. The rectifier is enclosed dust tight and cooled by circulating air. It may be used within the range from an admissible power up to a d.c. output of approximately 480 kilowatts. (*In German.*) Ein neuer Gleichrichter für industrielle Hochfrequenzerwärmungsanlagen. ***E. Jerratsch and H. J. Reich.*** *Nachrichtentechnik*, v. 10, no. 12, Dec. 1960, p. 551-556.

* **New Device for the Direct Measurement of the Carbon Potential of Furnace Atmospheres.** Preliminary conditions for indicating the carbon potential (C-level). Measuring methods. Description of a device for direct measurement of the carbon potential. Results. Applications. (*In German.*) Über ein neues Gerät zur unmittelbaren Messung des Kohlenstoff-potentials von Ofengasen. ***Theodor Schmidt and Joachim Wünning.*** *Stahl und Eisen*, v. 80, no. 26, Dec. 22, 1960, p. 1952-1954.

A High-Precision Photoelectric Photometer. The detector used is a Gillod-Boutry vacuum photocell with cesium-bismuth cathode surface having a basic sensitivity of 25 μA/lu. The photocurrent is measured by a simple circuit, using balanced electrometer tubes. The photometer is compact and portable. Battery replacement is only necessary every three months. Differences between successive readings and zeros repeat to $\pm 2/10^4$ when measuring a steady incidence of 10^{-4} lu. Zero drift is small, necessitating readings only every 15 min. Circuit stability is good, so that the simple balance adjustment need not be used more than twice daily, provided that the triodes are suitably matched. Due to undetermined causes day-to-day variations in sensitivity of 0.5% sometimes occur. ***O. C. Jones and C. L. Sanders.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 105-108.

Multiple Tube Collimator for Gas Beams. Collimator consists of a bundle of tubes with 20-μ radii, made by electrolytic removal of Cu wires from the plastic matrix in which they were embedded. ***G. R. Hanes.*** *Journal of Applied Physics*, v. 31, Dec. 1960, p. 2171-2175.

* **A Fabry-Perot Spectrometer for Auroral and Airglow Observations.** A 1-in. Fabry-Perot interferometric spectrometer employing mechanical scanning has been constructed to operate at low order. Such an instrument gives a resolution similar to that of a grating spectrometer but has, at that resolution, a much higher light-gathering power. The spectrometer is capable of resolving the sodium D lines in the twilight airglow, scanning once per minute. Some preliminary results on the variation of D_2/D_1 ratio during twilight are presented. This type of spectrometer should be useful for a number of other applications. ***G. G. Shepherd.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1560-1569.

* **A Test of the Nistri Photostereograph Model Beta Instrument!** Some of the operational features of the instrument are discussed and the results of a number of individual mechanical tests and monocular and stereoscopic grid measurements are reported. ***J. Hothmer.*** *Photogrammetric Engineering*, v. 26, no. 5, Dec. 1960, p. 720-725.

The Waveguide Spark Gap as a Standard for Microwave High Voltages. General description and considerations to be made are given. Applications are included. ***Robert D. Wengenroth.*** *IRE Transactions on Instrumentation*, v. I-9, no. 2, Sept. 1960, p. 214-216. (TK1 In6.6i Vis.)

Industrial Electric Furnaces and Appliances. Covers arc, resistance, and induction furnaces and dielectric heating. Includes data on skull melting and cold-mold arc furnaces. ***V. Paschkis and John Persson.*** 2nd Ed. 607 pp. 1960. Interscience Publishers, New York. (TK4661 P26i2)

A Ratio Transformer Bridge for Standardization of Inductors and Capacitors. Design, construction, operating characteristics and operating equations are discussed at length. An analysis of error sources and test results are given. Also future goals are included. ***D. L. Hillhouse and H. W. Kline.*** *IRE Transactions on Instrumentation*, v. I-9, no. 2, Sept. 1960, p. 251-257. (TK1 In6.6i Vis.)

A Precision RF Attenuation Calibration System. ***C. M. Allred and C. C. Cook.*** *IRE Transactions on Instrumentation*, v. I-9, no. 2, Sept. 1960, p. 268-274. (TK1 In6.6i Vis.)

* **New Synthetic Test Circuits for Testing High-Voltage Circuit-Breakers.** With the new Siemens test circuit, reliable tests can be made up to the highest voltages used at the moment. This is achieved in that, after the arc is extinguished, the current source, by reason of suitable design of the heavy-current circuit, supplies a transient voltage which corresponds with the system conditions, and this voltage is then followed immediately by the voltage from a high-voltage source. The resulting voltage variation is matched to a given variation of the transient voltage, or is selected in such a way that at least an equivalent voltage stressing is achieved. (*In German.*) Neue synthetische Prüfschaltung zur Prüfung von Hochleistungsschaltern. ***Eckhard Pflaum and Ernst Slamecka.*** *ETZ: Elektrotechnische Zeitschrift*, v. 82, Ausgabe A, no. 2, Jan. 16, 1961, p. 33-38.

Flying-Spot Integrating Densitometer. Permits rapid density measurements of photographic film. ***E. M. Deeley.*** *Electronics*, v. 34, no. 3, Jan. 20, 1961, p. 64-66.

Evaluation of Resistance Strain Gages at Elevated Temperatures. A facility for conducting such an evaluation is described. Typical results obtained during evaluation tests are given to show the capability of the equipment, to point out some of the problems encountered in the use of these gages, and to illustrate the need for comprehensive gage evaluation prior to use. The results shown are only indicative of the performance of the particular gage tested. Significantly different results might be otbained from other gage types. ***R. L. Bloss.*** *Materials Research & Standards*, v. 1, Jan. 1961, p. 9-15.

A Radio-Frequency Permittimeter. Discusses theory and analysis of the permittimeter and gives an example of a measurement of the complex dielectric constant of a ferrite ring core. ***R. C. Powell and A. L. Rasmussen.*** *IRE Transactions on Instrumentation*, v. I-9, no. 2, Sept. 1960, p. 179-184. (TK1 In6.6i Vis.)

A Transfer Instrument for the Intercomparison of Microwave Power Meters. Gives background and then discusses the general theory involved. Practical considerations along with experimental results are given. Finally, error analysis is discussed. ***G. F. Engen.*** *IRE Transactions on Instrumentation*, v. I-9, no. 2, Sept. 1960, p. 202-208. (TK1 In6.6i Vis.)

What Vacuum Furnaces Can Do for You. Description of resistance, induction, arc, and electron-beam types. *Steel*, v. 148, Feb. 6, 1961, p. 72-73.

* **A Liquid Level Detector and Timer for Use With a Volumetric Calibrating Tank.** An optical detector, which is operated by the change in refractive index of a suitable surface when immersed in a liquid, is described. A timing unit for a volumetric calibrating tank based on the liquid level detector has been constructed and complete details are given of the liquid level detector and gate units. Preliminary tests suggest a normal working accuracy of the order of 0.010 in. for level detection. ***J. J. Hunter.*** *Instrument Practice*, v. 15, Jan. 1961, p. 49-55.

Automatic Apparatus for Measurement of the Rate of Absorption or Evolution of Gas. An apparatus is described in which constant pressure is maintained as gas is absorbed or evolved by changing that volume of a threaded rod which is inside the apparatus. The change in volume of the gas is then equal to the change in volume of the rod inside the apparatus. Use of an escapement to turn the screw through constant-volume increments provides a simple method of automation. ***J. Scanlan and J. R. Dunn.*** *Journal of Scientific Instruments*, v. 38, Jan. 1961, p. 28-30.

Automatic Recording Dilatometer. The dilatometer described here enables changes in volume with time to be followed automatically and with high precision. Thus, chemical reaction rates can be obtained directly without the need for graphical differentiation. ***C. L. Bell.*** *Journal of Scientific Instruments*, v. 38, Jan. 1961, p. 27-28.

A Platinum Resistance Thermometer for Use at High Temperatures. The thermometer bulb is 36 mm x 5.5 mm and is contained in a recrystallized alumina sheath. The coil is wound from very pure Pt wire ($a = 0.003926$) and is freely exposed to dry air. The coil resistance at 0° C is 1.4 Ω and this permits measurements to the equivalent of 0.002 C. The thermometer is found to be stable to this limit on heating it for one hour at 1063 C. ***C. R. Barber and W. W. Blanke.*** *Journal of Scientific Instruments*, v. 38, Jan. 1961, p. 17-19.

Instrument for Recording the Dust Nuisance Emitted by Chimneys. The instrument measures the difference between the optical obscuration produced by a clean glass surface and that produced by the same glass surface when dust collected from a flue duct has settled on it. The method of collection is based on the assumption that vertical surfaces are more important in pollution than horizontal surfaces, and that coarse particles are more likely to cause nuisance than fine particles. The instrument has a novel recording method which enables it to operate over an unusually large range of signal levels. ***P. A. E. Crosse, D. H. Lucas, and W. L. Snowsill.*** *Journal of Scientific Instruments*, v. 38, Jan. 1961, p. 12-17.

* **Current Thinking on Meteorological Instrumentation for Use in Air Pollution Problems.** ***Gerald C. Gill, Harry Moses, and Maynard E. Smith.*** *Air Pollution Control Association, Journal*, v. 11, no. 2, Feb. 1961, p. 77 + 6 pages.

* **An Electron-Beam Parametric Amplifier for the 200 Mc/s Region.** Describes the design and performance of a low-noise amplifier of the quadrupole type. This is a transverse-field device in that the electron beam interacts with a radio-frequency field transverse to its direction of motion. Particular attention is directed to the conditions necessary to achieve the lowest overall noise figure of the amplifier. It is shown that these also lead to the broadest amplification bandwidth. ***G. O. Chalk.*** *Institution of Electrical Engineers, Proceedings*, v. 108, pt. B, no. 37, Jan. 1961, p. 125-132.

LUBRICATION AND FRICTION

* **Viscosity. I.** Fundamental principles; common methods of measuring viscosity of lubricants. *Lubrication*, v. 47, Jan. 1961, p. 1-12.

* **Investigation of the Gel Structure of Lubricating Greases by Electron Microscopy.** A correlation exists between the micromorphological structure and the rheological properties of lubricating greases. In lithium-calcium mixed base greases, the soaps form structural elements entirely independent of each other. (*In German.*) Elektronenmikroskopische Untersuchung der gelstruktur von Schmierfetten. ***F. Guba and E. Vámos.*** *Acta Chimica Academiae Scientiarum Hungaricae*, v. 25, no. 1, 1960, p. 85-98.

* **Centrifugal Purification of Lubricating Oil.** New system permits full use of the disc stack of the disk-type rotor oil purifier. ***Charles M. Ambler.*** *Lubrication Engineering*, v. 17, Jan. 1961, p. 34-39.

* **Testing Carbon for Seals and Bearings.** Use of test stand to obtain performance data on carbon-base material running nonlubricated. ***R. R. Paxton and W. R. Shobert.*** *Lubrication Engineering*, v. 17, Jan. 1961, p. 27-33.

* **The Lubrication of Rings and Travelers on Textile Spinning and Twisting Frames.** Advances made in applying extremely small quantities of lubricant. ***T. M. Murphy.*** *Lubrication Engineering*, v. 17, Jan. 1961, p. 24-26.

* **Laboratory Evaluation of Automotive Gear Lubricants.** Data are given for seven lubricants, all using the same base stock; field experience with some of these oils is related. ***S. R. Calish, Jr.*** *Lubrication Engineering*, v. 17, Jan. 1961, p. 14-23.

Investigation of Solid Film Lubricants and Sliding Contacts at Temperatures Above 1000°F. An experimental investigation of solid film lubrication and high-temperature sliding contacts was conducted to choose those materials that are most effective as high-temperature solid lubricants and also to study the sliding characteristics of materials at high temperatures. Studies were made of the sliding characteristics of metals, ceramics, and other materials that were developed. ***M. B. Peterson.*** *U. S. Atomic Energy Commission, APEX-569*, Feb. 1958 (Issued Aug. 1960), 63 pp. (UF767 Un3.1ap Contin.)

* **Investigation of Lubricating Oils for Two-Stroke Gasoline Engines. IV-V.** Intermittent cyclic duration tests. Evaluation of the results of engine dismantling carried out after the duration tests. (*In Russian.*) Ispytanie smazochnykh masel dlia dvukhtaknykh benzinovykh dvigatelei. IV-V. ***L. Vaĭta.*** *Acta Chimica Academiae Scientiarum Hungaricae*, v. 24, no. 4, 1960, p. 371-384.

When Designing Journal Bearings. Recommendations based on speed, load and temperature requirements. ***Bruce M. Dunham.*** *Product Engineering*, v. 32, no. 5, Jan. 30, 1961, p. 46-50.

MECHANICAL ENGINEERING

* **Rectangular Concrete Stress Distribution in Ultimate Strength Design.** Theory of broad applicability is developed. ***Alan H. Mattock, Ladislav B. Kriz, and Eivind Hognestad.*** *American Concrete Institute, Journal*, v. 32; *ACI Proceedings*, v. 57, no. 8, Feb. 1961, p. 875-928.

* **Use of Interpolation Formulae.** . . for design of structural members. ***A. Ormerod.*** *Engineering Materials and Design*, v. 4, Jan. 1961, p. 25-27.

Maximum Stress in Cylindrical Short Blocks. Equations for determining whether the block can stand both tension and compression, or only one, regardless of location of the load. ***S. Warren Kaye.*** *Product Engineering*, v. 32, no. 4, Jan. 23, 1961, p. 63 + 1 page.

Shear and Bending in Free-Beam Structures. An approximate method for calculating the dynamic response of beam-type structures that are subjected to suddenly applied forces. ***Matthew S. Smith.*** *Machine Design*, v. 33, Jan. 19, 1961, p. 127-131.

* **Testing of Wire Rope.** Suggestions are made for the design of fatigue-testing equipment. ***Ernst A. Franke.*** *Wire*, no. 50, Dec. 1960, p. 242-244.

A Stiffness Matrix for the Analysis of Thin Plates in Bending. A stiffness matrix is developed for an isotropic rectangular plate panel of uniform thickness for application to the analysis of thin plates of variable thickness in bending. The convergence characteristics of this matrix are demonstrated on simple problems with known exact, analog, and experimental solutions. The usefulness of the matrix in the determination of the elastic characteristics of thin, low aspect-ratio wings is exhibited. ***Robert J. Melosh.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 34 + 9 pages.

Steady Creep Bending of a Nonhomogeneous Beam. The bending stress in a steadily creeping, linearly viscous beam (with a viscosity coefficient varying exponentially through the

beam depth) is obtained by the use of the theory of generalized plane stress and compared to the solution based on elementary flexure theory. It is found that the smoother the bending moment distribution, or the shallower the beam, the better does the elementary solution approximate the generalized plane stress solution. Furthermore, the depth-to-span ratio below which the elementary theory is a good approximation depends not only on the parameter describing viscosity variation, but also on the face of the beam to which the load is applied. A useful and simple parameter gauging the range of validity of elementary flexure theory is seen to be the ratio of the applied transverse load stress to the resulting longitudinal bending stress (based on elementary theory) at the loaded face of the beam. ***Jerome L. Sackman.*** *Journal of the Aero/Space Sciences*, v. 28, Jan. 1961, p. 11 + 4 pages.

Dynamic Properties of Hydraulic Motors. How to use readily available specification data to predict the natural resonant frequency and damping ratio of a hydraulic motor and load. ***J. T. Hansen.*** *Machine Design*, v. 33, Jan. 19, 1961, p. 132-136.

High-Grade Fine-Pitch Gearing. A summary of the critical design, tooling, and inspection factors that mark the current state of the art. ***Richard L. Thoen.*** *Machine Design*, v. 33, Jan. 19, 1961, p. 155-162.

The Seals Book. Handbook to aid design engineers in selecting and applying seals, packings, and gaskets. *Machine Design* (Special Issue), Jan. 19, 1961, p. 1-136.

High Pressure-High Temperature Piping: A Transition in Engineering Design. Outlines some of the terminology of high pressure-high temperature steam piping, its materials and their correct applications, and its pressure-temperature relationships. ***Henry de Soto.*** *Heating, Piping & Air Conditioning*, v. 33, Feb. 1961, p. 105-107.

METALLURGY

* **Ferritic Alloy Steels for Power Plant.** Implies that benefit can be derived from service failure to strengthen the various assessment techniques for material selection and suggests this might take the form of creep and corrosion studies, greater emphasis on mechanisms rather than test methods, and, for weldability, exploration of the metallurgical and mechanical aspects of plastic deformation. ***M. G. Gemmill.*** *Alloy Metals Review*, v. 9, no. 98, Dec. 1960, p. 2-8.

Reference File: Cryogenic Materials. Graphical data on stainless, aluminum, and beryllium alloys. *Space/Aeronautics*, v. 35, no. 1, Jan. 1961, p. 72-73.

* **Europium and Europium Alloys.** Ag-Cd-Eu alloys with up to about 5 wt.% Eu have suitable mechanical properties, machinability, and corrosion resistance toward water at high temperature to satisfy the most important requirements for a material for use in control rods of thermal nuclear reactors. (*In German.*) Europium und Europium-Legierungen. ***R. Lesser and E. Erben.*** *Metall*, v. 15, Jan. 1960, p. 30-33.

* **The Refractory Noble Metals and Rhenium.** It is considered that the most significant effect of these small additions of platinum metals is the reduced solubility for O through increase in the valence electron concentration. *Platinum Metals Review*, v. 5, no. 1, Jan. 1961, p. 19-20.

Melting and Casting of the Refractory Metals Molybdenum, Columbium, Tantalum, and Tungsten. The technology of melting and casting refractory metals is considered from the standpoint of ingots and shaped castings. The production of ingots is more advanced than is the production of shaped castings. Molybdenum and Cb have been centrifugally cast with some success. Shaped castings of Ta have been produced experimentally. No satisfactory method for the production of shaped W castings is presently available. There is an indicated need for shaped castings of the refractory metals, and further development work appears to be justified. The cold-crucible induction furnace, presently under development for Ti, might be adapted for the refractory metals. ***W. H. Johnson.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Report No.* 139, Nov. 18, 1960, 30 pp. (TN799.T5 B32.7t Vis.)

Metallurgical Progress in Canada. Information from more than a score of laboratories and research departments, industrial, educational and governmental, indicates vigorous advances in all branches of metallurgy, from ore beneficiation to production of dislocations in whiskers, and from steel manufacture to atomic energy. ***Harold J. Roast.*** *Metal Progress*, v. 79, no. 1, Jan. 1961, p. 117-120.

How the Russians Are Using Ultrasonics in Metallurgy. In the Soviet Union, ultrasonic energy is being used to degas molten metals, speed diffusion processes (such as carburization), accelerate aging of Al alloys and improve weld quality. Other work with ultrasonics is also being done. ***Arthur B. Tesmen.*** *Metal Progress*, v. 79, no. 1, Jan. 1961, p. 79-83.

International Figures in the History of the Man-Made Metal Plutonium. An outline of work done in various laboratories in the U.S., Canada, England, France, and Russia, giving credit to the principal scientists and metallurgists. ***Arthur S. Coffinberry.*** *Metal Progress*, v. 79, no. 1, Jan. 1961, p. 84-88.

* **Weldable As-Cast Nickel Aluminum Bronze Composition and Microstructure.** The minimum percentage of Al needed for a weldable structure is close to 9%, and the optimum as-cast structure in the thickness range considered is obtained with 9.5% Al at 5, 4, and 0.5% Ni, Fe and Mn, respectively. Pb and Si, elements considered as "detrimental," do not adversely affect weldability at levels of 0.10 and 0.18%, respectively, in an otherwise optimum composition. Optimum mechanical properties obtained to date and relationships between metallographic structure, mechanical properties and weldability, are discussed. ***M. L. Foster and S. Goldspiel.*** *Modern Castings*, v. 39, Feb. 1961, p. 72-92.

METALS—CORROSION

* **The Corrosion of Condenser Tubes.** The identification, mechanism and prevention of the corrosion of nonferrous condenser tubes are described. Success in preventing attack on the water side was achieved by paying attention to metallurgical and design factors; today, interest is directed towards the steam side, and treatment must be considered in relation to the whole steam-water system. ***D. G. Kingerley.*** *British Chemical Engineering*, v. 6, Jan. 1961, p. 20-25.

The Effect of Sealing in Laboratory Corrosion Tests of Anodized Aluminum. A Short Study. Of the various tests which were investigated, some measure the degree of sealing, others the pitting resistance and one, both these characteristics in differing degree. Among those tests which measure only the degree of sealing, the results show that the acidified sodium sulfite immersion test and the sulfur dioxide humidity test both provide good discrimination. The type of test that measures both the degree of sealing and the pitting resistance is most useful. Of the various procedures examined, only the acidified salt spray test falls in this class. It provides an indication of sealing quality and deteriorates the anodic film in a manner similar to that which occurs in service environment. ***W. E. Cooke and R. C. Spooner.*** *Plating*, v. 48, Jan. 1961, p. 42-45.

The Low-Temperature Interaction of Oxygen With Evaporated Germanium Films. Both the initial rapid chemisorption and the slower incorporation process effect considerable loss of area and extensive measurements of both the thermal and oxidative sintering have been made. This major loss in area on oxidation is a consequence of the mechanism of oxidation, although in part it may arise from the exothermic nature of the sorption processes. The first layer comprises oxygen adatoms predominantly covalently bonded to the germanium surface atoms and higher layer absorption is due to the attachment of oxygen molecular ions at specific localities. ***M. J. Bennett and F. C. Tompkins.*** *Royal Society, Proceedings*, v. 259, ser. A, Nov. 22, 1960, p. 28-44.

* **Influence of Surface Layers on the Sensitivity to Stress Corrosion of Austenitic and High-Tensile Steels.** With steel alloys, stress corrosion cracking is one of the most unpleasant corrosion phenomena. In the case of austenitic chrome nickel steels, this type of corrosion is generally caused by solutions containing halides. The sensitivity of austenitic steels depends

on their alloy composition. In general, steels containing ferrite are less sensitive, as the ferrite is attacked first so that the austenite is cathodically protected. The phenomena encountered in the micro-range can also be transferred to the macro-range, inasmuch as the austenitic material is connected with a more electro-negative metal. For instance, the chromium-plating of austenitic structural members gives rise to a ferritic surface zone rich in Cr which, in certain electrolytes, acts as an anode in respect of the parent material and provides a cathodic protection for the austenite. Stress corrosion cracking of high-tensile ferritic steels in acid solutions containing hydrogen sulfide can be ascribed to the penetration, into the steel, of the atomic hydrogen thus formed. The crack sensitivity can be reduced by an anodic current load, as the development of H will then take place at the cathode. It was found that lead coating is a suitable cathode. (*In German.*) Einfluss von Deckschichten auf die Spannungsrisskorrosions-empfindlichkeit austenitischer Stähle und hochfester Stähle. ***E. Baerlecken and K. Lorenz.*** *Werkstoffe und Korrosion*, v. 11, Dec. 1960, p. 744-749.

* **Calcination of Cold and Hot Water Pipes Made of Copper or Iron.** Although the carbonate hardness of natural waters mainly consists of calcium and magnesium compounds, the calcium compounds are the only ones whose solubility is affected by carbonic acid. In this connection, a distinction must be made between genuinely dissolved carbonic acid and carbonic acid dissolved under pressure, and also between pseudo-dissolved and electrochemically ineffective carbonic acid. The deposition of calcium compounds on pipe surfaces (calcination) depends on the condition of the carbonic acid and on the reaction of the pipe materials to water. The latter influence predominates, i.e., a higher chemical resistance results in a lesser degree of calcination. (*In German.*) Verkalkung von Kalt- und Warmwasserleitungen aus Kupfer und Eisen. ***L. W. Haase.*** *Werkstoffe und Korrosion*, v. 11, Dec. 1960, p. 737-739.

* **Effect of Pressure on the Oxidation of Iron and of Steels by Carbon Dioxide.** Systematic tests conducted at 525 C, the rate of oxidation of Fe, of carbon steels and of a steel with 3% Cr is increased by partial pressure of CO_2 between 1 and 16 kg/cm². (*In French.*) Influence de la pression sur l'oxydation du fer et des aciers par l'anhydride carbonique. ***Michel Colombié.*** *Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences*, v. 251, no. 25, Dec. 19, 1960, p. 2938-2940.

* **Electrochemical Behavior of Steel in Concrete.** The delaying of corrosion of steel in concrete occurs at the expense of a cathodic process dependent on the difficulty of O_2 to reach the steel surface, and at the expense of an anodic process, that is the accumulation of products of corrosion which suspend the corrosion process of the metal. The high protective properties of Portland, as compared with cements containing sulfates and and chlorides, can be explained by the emergence of a special passive situation. The surface compounds formed on the steel partake of the electrical regeneration. (*In Russian.*) Elektrokhimicheskoe povedenie stali v betone. ***V. S. Artamonov.*** *Zhurnal Prikladnoĭ Khimii*, v. 33, no. 10, Oct. 1960, p. 2311-2319.

* **Stainless Steel Increases Life of Sulphur Dioxide Headers.** Headers of high Cr cast iron handling SO_2 at metal temperatures of 1800 to 2000 F had to be replaced every 2-2½ years. A replacement elbow of Fe-Cr-Ni cast alloy type HH installed over 15 years ago is still in operation. *Pulp and Paper Magazine of Canada*, v. 62, Jan. 1961, p. 77-78.

Use of the Marker Method in Studying the Mechanism of Oxidation of Metals. The results obtained by marker method should be interpreted very cautiously because of the possibility of secondary processes which can disturb the location of the marker in the scale layer. ***S. Mrowec and T. Werber.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 819-821.

How to Choose Lead Linings for Process Vessels. There are five ways to line a vessel with lead—each has advantages and limitations. Choice is made based on lead's properties and operating conditions in the vessel. ***Robert L. Ziegfeld.*** *Chemical Engineering*, v. 68, Jan. 23, 1961, p. 164 + 3 pages.

The Effect of Pressure on the Second Stage Parabolic Rate in the Oxidation of Titanium. The controlling step in the second parabolic stage in the oxidation of Ti is the diffusion of gaseous O_2 through the porous scale, and in particular

the results show that the parabolic rate constant is linearly dependent on O_2 pressure, as required by theory. ***J. Stringer.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 810-811.

a

A Study of the Formation of Anodic Oxide Films on Uranium. I. An Optical Reflectivity Method for Determining the Kinetics of Film Growth. An optical reflectivity method is described which has been used for investigating film growth during the anodic oxidation of U, and which may have a wider application in the field of anodic oxidation provided the optical constants of the film can be determined. In the present study, multiple-beam interferometry and polarized light methods have been used to measure the optical constants of U and the anodically formed film. Using the former method, a value of 1.94 has been obtained for the refractive index of the oxide. ***A. E. Stebbens and L. L. Shreir.*** *Electrochemical Society, Journal*, v. 108, Jan. 1961, p. 30-36.

b

New Type of Iron Bacteria Found in Salt Water. Iron bacteria (Gallionella) have recently been found in water-source wells in the Long Beach area. Iron bacteria are one of the groups of microorganisms having considerable economic importance in the operation of water-flooding installations in the petroleum industry. They are a known cause of corrosion in fresh water and must now be considered as a source of trouble in salt-water supplies. ***J. M. Sharpley.*** *Oil and Gas Journal*, v. 59, no. 4, Jan. 23, 1961, p. 89-90.

c

* **Intergranular Corrosion of Austenitic Steels Containing 24% Cr and 19% Ni.** Further proof is given that intergranular corrosion of austenitic stainless is a result of impoverishment of chromium in the grain boundaries due to precipitation of chromium carbides. ***Vladimir Cihal, Pavel Grobner, Jaroslav Jezek, and Rudolf Pospisil.*** *Metal Treatment and Drop Forging*, v. 28, Jan. 1961, p. 5-13.

d

The Oxidation and Corrosion of Zirconium and Its Alloys. V. Mechanism of Oxide Film Growth and Breakdown on Zirconium and Zircaloy-2. Theories of the mechanism of film growth and breakdown on Zr and zircaloy-2 are discussed in the light of recent evidence obtained at A.E.R.E. and a further explanation of the observed phenomena is offered. ***B. Cox.*** *Electrochemical Society, Journal*, v. 108, Jan. 1961, p. 24-30.

e

The Oxidation of Tin. I. The Kinetics of Oxidation of Pure Tin and the Effects of Temperature and Oxygen Pressure. By means of a vacuum microbalance, the rates of oxidation of pure Sn were determined over a temperature range of 150-220 C, and for several different pressures of 0 in the range of 10^{-5} mm to 500 mm Hg. For 0 pressures of 1 mm and above, the oxidation appears to proceed with time in three stages: (a) initially, the rate is low, but it increases to a maximum; (b) it then decreases and follows a direct logarithmic relationship; and (c) finally, for long times and thick films, the rate becomes erratic, either increasing rapidly or leveling off. Below an 0 pressure of 1 mm, the oxidation rate increases continuously with time, and the rate-determining step in the kinetic process appears to be the dissociation of 0. ***W. E. Boggs, R. H. Kachik, and G. E. Pellissier.*** *Electrochemical Society, Journal*, v. 108, Jan. 1961, p. 6-12.

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h

* **Techniques Employed in a Study of the Properties of Flue Gases From Large Oil-Fired Boilers.** The equipment and instrumentation as developed for the measurement of metal corrosion, SO_2 and SO_3 content of the flue gas, and the flue-gas solids burden, enable a rapid assessment of the boiler performance to be made. The corrosion probe described is of light weight construction, and the whole assembly is readily portable. Its design makes it possible to carry out measurements at two temperature levels during one exposure, and a complete corrosion profile may be obtained in two working days. ***J. Stein, B. G. S. Taylor, and G. R. Wade.*** *Institute of Fuel, Journal*, v. 34, Jan. 1961, p. 8-16 + 2 plates.

i

j

The Oxidation of Tin. II. The Morphology and Mode of Growth of Oxide Films on Pure Tin. Oxide films formed during the study of the kinetics of oxidation of pure Sn, under different conditions of time, temperature, and O_2 pressure, were examined by means of electron microscopy and electron diffraction. Under all the conditions investigated, the oxide nucleates at numerous sites on the Sn surface and spreads laterally, until the surface is essentially completely covered with

k

oxide. For O_2 pressures of 1 mm Hg and above, at all temperatures investigated, the oxide nuclei develop into microscopic, wheel-shaped "growth centers" about 1 micron in diameter. At O_2 pressures below 1 mm, the oxide grows in a dendritic manner. The electron diffraction results show that only one crystalline oxide, alpha-SnO, is formed under all of the oxidation conditions investigated. ***W. E. Boggs, P. S. Trozzo, and G. E. Pellissier.*** *Electrochemical Society, Journal*, v. 108, Jan. 1961, p. 13-24.

The Compatibility of UO_2 With the Refractory Metals and Refractory Metal Thermocouples at Temperatures Above 1750°C. Tungsten, Re, Ta, Mo, and Nb were heated in contact with UO_2 at temperatures up to 2660 C. Tungsten and Re exhibited no evidence of reaction. Uranium dioxide adhered slightly to Mo, Ta, and Nb, but no attack could be detected. Thermocouples of the five metals were fabricated and tested up to 2200 C with and without UO_2 present in the system. The W-Re, Mo-Re, and Mo-W combinations were found to be the only promising thermocouples. The W-Re thermocouple proved to be the most satisfactory, exhibiting good sensitivity and stability. ***J. J. Byerley.*** *Atomic Energy of Canada, Limited, AECL No.*-1126, Oct. 1960, 24 pp. (QC770 At71a Contin.)

How to Prevent Stress-Corrosion Cracking of Copper Alloys. ***David H. Thompson.*** *Chemical Engineering*, v. 68, Feb. 6, 1961, p. 130 + 2 pages.

The Nature, Cause and Effect of the Porosity in Electrodeposits. VI. Note on a Magnetic Method of Detecting Corrosion Currents. An experiment is described which demonstrates a magnetic method of detecting the electric current of a galvanic cell. The galvanic cell is placed in a magnetic field. Interaction of the moving electric charges with the magnetic field results in motion of the electrolyte. ***Fielding Ogburn and William H. Roberts.*** *Plating*, v. 48, Feb. 1961, p. 168-169.

An Electron-Microscopic Study of the Corrosion of Electroplated Nickel. The structural changes occurring in electroplated Ni exposed to outdoor corrosion were determined by electron microscopy. It was found that the structures of all deposits became similar after a one-year exposure regardless of the as-plated appearance. The formation of pits which reached to the basis metal was accelerated by the addition of S-containing agents to the plating bath. Pitting as observed by electron microscopy could not be related to pitting seen with the unaided eye. Electron microscopy appears to be a valuable tool in the study of corrosion of electrodeposits. ***Rolf Weil.*** *Plating*, v. 48, Feb. 1961, p. 163-167.

* **Intercrystalline Corrosion of Aluminum Materials.** Pure Al, characterized by outstanding chemical properties shows at elevated temperatures, such as occur in atomic reactors, and in the chemical industry, a marked tendency for intercrystalline corrosion, which was heretofore not observed with materials containing Al. It is demonstrated that the tendency for intercrystaline corrosion which increases with the purity, is influenced in the aqueous solution as well as by the pH-value and the constitution of the attacking liquid. Various metal additions—even in small percentage—counteract this tendency for intercrystalline corrosion; moreover certain metals, like Be, Zr, Cr, and Mn do not impair the valuable chemical and physical properties of pure Al. On the basis of extensive observations, these peculiar phenomena of intercrystalline corrosion could be explained through electrochemical processes. (*In German.*) Interkristalliner Zerfall von Aluminium-Werkstoffen. ***E. Nachtigall.*** *Radex Rundschau*, 1960, no. 6, Dec., p. 373-388.

* **Study by Means of Radioactive Tracers of the Enrichment in Impurities Which Occurs During the Oxidation of Steels.** The use of radioactive tracers confirms the accumulation at the metal/oxide interface of metallic (Cu, Co, Cr, W) and metalloid (As, P, S) impurities when a steel or binary ferrous alloy is oxidized at elevated temperatures. In particular, the study of an Fe-S alloy containing 0.021% sulfur shows that the kinetics of oxidation in H_2-H_2O atmospheres exhibits a linear law followed by a parabolic law—the linear oxidation is explained by interface reaction limited by the chemical absorption of the O_2 by the oxide; the S contained in the oxidized metal fraction is concentrated at the interface in the form of iron sulfide crystals. (*In French.*) Étude, au moyen des radioindicateurs, de l'enrichissement en impuretés au cours de l'oxydation des aciers. ***Ch. de Beaulieu, M. Cagnet, and J. Moreau.*** *Revue de Métallurgie, Mémories Scientifiques*, v. 57, no. 11, Nov. 1960, p. 863-875.

* **Materials of Construction for Chemical Plant: Platinum.** The use of Pt and its alloys as materials of construction for chemical plants is discussed. The outstanding characteristic of Pt is its resistance to chemical attack, especially to oxidation in air at high temperatures. This property, together with its high melting point, is found of unique value in a number of specialized applications in chemical plant where corrosion and physical conditions are exceptionally severe. ***J. A. Stevenson.*** *Chemical & Process Engineering*, v. 42, Jan. 1961, p. 31-36.

METALS—EXTRACTION AND REFINING

Investigation of Bessemer Converter Smoke Control. A 300-lb experimental Bessemer converter was assembled to simulate blowing conditions in a commercial vessel. Measurements of smoke and dust were also made in the field on a 30-ton commercial vessel. During normal blows, the dust loading from the laboratory converter averaged 0.51 lb per 1000 lb of exhaust gas. This was similar to the exhaust-gas loading of a commercial vessel. The addition of H to the blast gas of the laboratory converter caused a decided decrease in smoke density. Smoke was also reduced markedly when methane or ammonia was added instead of H. ***A. R. Orban, J. D. Hummell, and R. B. Engdahl.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1039-1049.

The Application of Ultrasonic Energy to Ingot Solidification. I. The application of this technique to the consumable-electrode arc melting process shows that the columnar mode of freezing may be effectively suppressed yielding an ingot structure consisting predominantly of equiaxed grains. The results support the contention that the ultrasonic vibrations increase the nucleation frequency in the layer of liquid adjacent to the freezing interface. ***D. H. Lane, J. W. Cunningham, and W. A. Tiller.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 985-990.

Testing of Lump Ores for Their Behavior in the Blast Furnace. Laboratory experiments on numerous ores including ten magnetite, sixteen hematite, six low-grade mainly oolitic ores for mechanical properties, tendency to decrepitate (burst) in furnace, and reducibility. Comparsion of actually attained operating results with those predicted by laboratory test data. ***H. Birnbaum, L. von Bogdandy, and W. Janke.*** *Henry Brutcher Translation No.* 4852, 25 pp. (From *Stahl und Eisen*, v. 80, no. 12, 1960, p. 781-788.) Henry Brutcher, Altadena, Calif.

An Economic Evaluation of the Use of Iron Ore Pellets [as Against Sinter] in the Blast Furnace. ***I. S. Kagan, Kh. P. Zaitsev, N. S. Snagovskaya, E. N. Volkova, and I. A. Volokh.*** *Henry Brutcher Translation No.* 4935, 21 pp. (From *Izvest. VUZ - Chern. Met.*, no. 6, June 1959, p. 145-154.) Henry Brutcher, Altadena, Calif.

Practical Experience in the Vacuum Degassing of Open-Hearth Steel Heats. ***H. J. Därmann.*** *Henry Brutcher Translation No.* 4895, 14 pp. (From *Berg- und Hüttenmänn. Monatshefte*, v. 105, no. 6, 1960, p. 144-149. Henry Brutcher, Altadena, Calif.

Fundamentals on the Degassing of Steel by the Closed-Circuit Process. Partly or fully killed steels can be treated and final killing and alloying may conveniently be done in the ladle. ***H. Maas.*** *Henry Brutcher Translation No.* 4896, 16 pp. (From *Berg- und Hüttenmänn. Monatshefte*, v. 105, no. 6, 1960, p. 151-157.) Henry Brutcher, Altadena, Calif.

New Technique of Deoxidizing Steel With Aluminum. New technique of introducing Al metal into steel held in ladle. ***A. R. Bazilevskii and P. I. Kovalev.*** *Henry Brutcher Translation No.* 5015, 3 pp. (From *Metallurg*, no. 9, 1960, p. 16-17.) Henry Brutcher, Altadena, Calif.

Study of Metallothermic Process Applied to Iron and Steel Production. Two-stage process of iron and steel production; underlying basic considerations. ***A. Wimmer.*** *Henry Brutcher Translation No.* 4941, 28 pp. + 5 figures. (From *Stahl und Eisen*, v. 80, no. 22, 1960, p. 1469-1477.) Henry Brutcher, Altadena, Calif.

Desulfurization of Pig Iron Outside the Blast Furnace. ***L. Ya. Shparber.*** *Henry Brutcher Translation No.* 5016, 2 pp. (From *Metallurg*, no. 2, 1960, p. 8-9.) Henry Brutcher, Altadena, Calif.

Crucible Steel Starts New Vacuum Degassing Unit at Midland Works. Describes operating procedures of the Dortmund-Horder ladle degassing process. *Iron and Steel Engineer*, v. 38, Jan. 1961, p. 183-184.

Removing Volatile Metals From Lead and Tin by Vacuum Distillation. Although Cd and Zn can be removed from Pb and Sn, down to about 0.1 atomic %, further removal is exceedingly slow. For less volatile metals or metals such as Mg, which form intermetallic compounds with Pb and Sn, the practical limits is about 1%. ***H. S. Caldwell, Jr., M. J. Spendlove, and H. W. St. Clair.*** *U. S. Bureau of Mines Report of Investigations* 5703, 1960, 12 pp. (TN21 Un3r Room 290)

* **Fuel and Power Required for Making Steel in the LD Process.** The amounts of heat available in LD steelmaking, viz., the physical heat of the hot metal; the heat of oxidation of the accompanying elements including Fe going into the slag and into the dust; and the combustion of the process gases above the mouth of the crucible, are compared with the utilized amounts of heat. These latter are composed of the heat contents of the liquid steel and the liquid slag, of the heat required for the direct reduction of ore additions and of the heat content of the steam generated in the waste heat boiler. ***Kurt Rösner and Ferdinand Dobrowsky.*** *Institute of Fuel, Journal*, v. 34, Jan. 1961, p. 3-7.

Horizontal Continuous Casting Plant for Large-Tonnage Steels. Results of experiments. ***R. Dawirs.*** *Henry Brutcher Translation No.* 4814, 7 pp. (From *Stahl und Eisen*, v. 80, no. 7, 1960, p. 444-446.) Henry Brutcher, Altadena, Calif.

Use of Top-Gas Composition for Analysis and Control of the Thermal Condition of a Blast Furnace. Successful elimination of the usual delays in the control of the temperature distribution in blast furnaces when based on iron composition, flushing slag temperature and working of the tuyeres. ***A. N. Pokhvisnev and N. K. Zhilkin.*** *Henry Brutcher Translation No.* 4871, 31 pp. (From *Izvest. VUZ–Chern. Met.*, 1959, no. 9, Sept., p. 29-45.) Henry Brutcher, Altadena, Calif.

Some Observations on Steel Remelted in the Vacuum-Arc Furnace. ***G. Ogiermann.*** *Henry Brutcher Translation No.* 4897, 9 pp. (From *Berg- und Hüttenmännische Monatshefte*, v. 105, no. 6, 1960, p. 157-161.) Henry Brutcher, Altadena, Calif.

METALS—FINISHING, POLISHING AND CLEANING

Removal of Scale From Steel Rod by Stretching. Steel rods of different C contents were oxidized for 5 and 20 min at 700, 800, and 900 C. They were stretched in a tensile machine and the scale that spalled off was weighed and screened. The influence of the independent variables, time and temperature of oxidation, and C content of the rod, on the weight of scale formed, amount and proportion of residual scale, and particle size of spalled-off scale, was assessed by the use of standard statistical techniques; the separate effect of each variable was determined and random scatter excluded. The total amount of scale and weight of adherent scale increased with time and temperature of oxidation, while the proportion of adherent scale was independent of these factors but tended to increase with C content; particle size of the spalled-off scale was independent of C content of duration of scaling but increased with temperature. ***K. Sachs and T. Pitt.*** *Iron and Steel Institute, Journal*, v. 197, pt. 1, Jan. 1961, p. 1-8.

* **Preparation of Tags for Soldering.** *Tin and Its Uses*, no. 50, 1960, p. 10-12.

Centrifugal Force Adds Luster to Barrel Tumbled Parts. Two new tumbling machines, one dry and the other wet, both incorporate centrifugal force in their cycles. Extremely bright results are obtained in little time. ***R. R. Irving.*** *Iron Age*, v. 187, no. 5, Feb. 2, 1961, p. 84-85.

METALS—FOUNDRY PRACTICE

Production of Large 13% Chromium Steel Castings. Castings for water turbines are difficult to make and the most suitable steel, 13% Cr, is prone to tears and inclusions. Gives details of the foundry practice best calculated to overcome the difficulties, including the fettling and heat treatment. ***F. Mařan.*** *Iron & Steel*, v. 34, no. 1, Jan. 1961, p. 7-10.

* **Thoughts on Phosphoric Cast Iron.** Reviews critically the present situation of phosphorus in Fe and puts forward evidence for and against it being regarded as an essential element in the composition of modern cast iron. ***R. V. Riley.*** *British Foundryman*, v. 53, Dec. 1960, p. 549-555.

* **The Structure and Properties of Sand-Cast Gunmetals.** The object of the work was to determine whether the existing commercial alloys have the optimum combination of properties, taking into consideration their cost and the effects of porosity in poorly fed castings. The influence of porosity is important because one reason for the popularity of gunmetals is that pressure-tight castings may be made in them without extensive feeding. Elevated-temperature creep properties were determined in alloys selected largely for their high pressure-tightness and strength in porous sections. ***J. E. Stolarczyk.*** *British Foundryman*, v. 53, Dec. 1960, p. 531-548.

* **Planning a General Ironfoundry.** Observations are made on the early planning of two general foundries in respect to buildings and internal layouts to suit the making of castings of mixed qualities and sizes. Stress is laid on the need to employ the maximum practicable use of mechanized mobile and location aids in the movement and processing of materials. ***E. Longden.*** *British Foundryman*, v. 53, Dec. 1960, p. 555-564.

* **Sand Circulation in the Foundry.** The sand circuit as related to the total movement of materials, molding materials, reception and storage, from old sand to backing sand, preparation of the facing sand, mechanized recirculation of the shake-out sand, mixing plant, distribution of the finished sand, molding shop for heavy castings, rubbish disposal and sand reclaiming. Rentability of sand reclaiming plants is also discussed. (*In German.*) Sandkreislauf in der Giesserei. ***Albert Dünner.*** *Giesserei*, v. 47, no. 26, Dec. 29, 1960, p. 753-762.

* **Experiences Made With Automatically Recording Spectral Analysis Apparatuses and an X-Ray Diffractometer in the Laboratory of a Foundry.** Preparation of the specimens and apparatus used including fluorspar vacuum polychromator, medium prism spectrometer and X-ray vacuum diffractometer. Functioning of the apparatuses are discussed. (*In German.*) Erfahrungen mit selbstregistrierenden Spektralgeräten und einem Röntgendiffraktometer im Giessereilaboratorium. ***Hans Zeuner.*** *Giesserei*, v. 47, no. 26, Dec. 29, 1960, p. 747-753.

Close-Tolerance Light Metal Castings. Tolerances as close as plus or minus 0.002 in. can be met by using a variety of casting methods. Outlines what the foundry industry has accomplished with plaster and shell molds. ***John Armstrong.*** *Foundry*, v. 89, Feb. 1961, p. 58-63.

Furan Hot Box Core Binders. Furan resins are gaining wide interest as foundry sand binders because of their properties. Outlines some applications and explains how to use the latest developments in hot box cores. ***Wayne H. Buell.*** *Foundry*, v. 89, Feb. 1961, p. 64-68.

Sound Waves Improve Diecasting Quality. Use of a mechanical vibrator on production diecasting equipment has shown these results: better die fill; faster freezing cycle; fine-structured, porosity-free castings. ***John A. Weber and Earle W. Rearwin.*** *Foundry*, v. 89, Feb. 1961, p. 69-71.

Modernized Foundry Builds Business on Conversions. The addition of new equipment, a modern approach to management, the use of other processing techniques such as coining, and an aggressive effort to convert parts to castings are paying off. ***Robert H. Herrmann.*** *Foundry,* v. 89, Feb. 1961, p. 72-76.

* **Refractory Mold Coating Aids Casting of Aluminum Gear Housings for Automatic Washers.** Refractory mold coating minimizes scrap and guards against shrinkage in washing machine castings. *Modern Metals,* v. 16, no. 12, Jan. 1961, p. 42.

Gating Magnesium Sand Castings. Proper gating practice is important in casting magnesium because of the high strength-weight ratios usually required. Gating for achievement of optimum properties is outlined. ***Robert C. Boehm.*** *Foundry,* v. 89, Feb. 1961, p. 80-87.

Hold That Temper! Moisture affects almost every property of molding sand. Explains the nature and causes of the effects of moisture content. ***W. P. Winter.*** *Foundry,* v. 89, Feb. 1961, p. 77-79.

* **Mechanism of the Evolution of Longitudinal Cracks on the Billet Surface.** The mechanism of the evolution of cracks on the billet surface is essentially the same as that in the normal ingot casting. In continuous casting, however, because of the higher linear rate of casting, the tendency of the surface crack is greater than that in the normal ingot casting. Results of the experiment and the calculation reveal that the stress has a possibility of being greater than the strength. That is, the longitudinal crack may appear as soon as the billet loses contact with the mold. (*In Japanese.*) ***Yoshio Aketa and Kiyoto Ushijima.*** *Tetsu to Hagane (Journal of the Iron and Steel Institute of Japan),* v. 46, no. 14, Dec. 1960, p. 1733-1740.

Diecasting. The diecasting process, diecastable metals, diecasting and its competitors, making castings in metal molds, modern diecasting techniques and other problems are discussed. ***H. K. Barton.*** *Engineers' Digest,* v. 21, Dec. 1960, p. 77-126.

* **Effects of Heat Treatment on the Structural Stability and Age Hardening of Titanium Alloy Ti3Al5Cr.** The cooling rate from the β-region was studied. Microscopically in this alloy up to 20,000 enlargement reveals no ω-precipitation. A slight ω-line only is revealed by radiographic examination. The precipitation must be assumed to occur inside the crystal lattice producing an increase in hardness and strength at the expense of ductility. (*In German.*) Einflüsse der Wärmebehandlung auf die Gefügestabilität und Aushärtung der Titanlegierung Ti3-Al5Cr. ***H. Wiegand and K. H. Illgner.*** *Metall,* v. 15, Jan. 1961, p. 23-29.

* **Effect of Heating Rate in Heat Treatment on Steel Sheets for Galvanizing.** A rapid heating resulted in a smaller grain size than that in a slow heating immediately after recrystallization. An X-ray photograph, which was taken with the recrystallized specimens, showed that a rapid heating yielded more grains with random orientations. A_3 transformation was completed at 950 C in slow heating and at 980 C in rapid heating. The rapid heating refined the grain size more effectively than the slow heating A_3 transformation. (*In Japanese.*) ***Seita Sakui and Tsutomu Mori.*** *Tetsu to Hagane (Journal of the Iron and Steel Institute of Japan),* v. 46, no. 14, Dec. 1960, p. 1740-1744.

Some Experiments in Controlled Low Temperature Stress Relief. Applied to welded mild steel pipes in which the transverse residual stresses are high. ***R. N. Parkins.*** *British Welding Journal,* v. 8, Jan. 1961, p. 24-29.

Surface Hardening of Steels. I. Hardening Methods. ***Lester F. Spencer.*** *Machine Design,* v. 33, Jan. 19, 1961, p. 148-153.

* **Systematic Approach to Sand Design and Control. III. The Mulling Effect.** Deals with the effect of mulling time and method of additions to a sand-clay-water system in relation to green compression strength, green shear strength, green tensile strength, ratio of green compression strength to green shear strength, density, dry compression strength and dry shear strength. The clays investigated are western and southern bentonite and fireclay. ***G. J. Vingas and A. H. Zrimsek.*** *Modern Castings,* v. 39, Feb. 1961, p. 93-109.

Use of Steel Molds [in Conjunction With Sand Cores] for Large Steel Castings. Study of the various factors affecting the quality of steel molds. ***S. I. Smolenskii, N. N. Guglin, G. F. Zasetskii, A. K. Provornyi, and V. A. Tyutev.*** *Henry Brutcher Translations No.* 4849, 11 pp. (From *Liteinoe Prozvodstvo,* no. 3, 1959, p. 23-26.) Henry Brutcher, Altadena, Calif.

Fluidity Characteristics of Liquid Cast Iron Flushed With Methane Gas. Action of methane compared with that of Mg and other inoculants. ***L. Sofroni, C. Cosneanu, and E. Nicoloiu.*** *Henry Brutcher Translation No.* 4939, 18 pp + 3 figures. (From *Studii si Cercetari de Metalurgie,* v. 4, no. 4, 1959, p. 525-535.) Henry Brutcher, Altadena, Calif.

Furnace [Specifically, Deoxidizing] Practice for Steel Castings. Improvement of mechanical properties of cast steel by substitution of (1) normalizing plus tempering; (2) quenching plus tempering; (3) or alloying, normalizing + tempering for the customary anneal followed by furnace cooling. Recommended Al addition for highest notch toughness at subzero temperatures. ***N. N. Dobrokhotov.*** *Henry Brutcher Translation No.* 4945, 2 pp. (From *Liteinoe Proizvodstvo,* v. 9, no. 12, 1958, p. 8). Henry Brutcher, Altadena, Calif.

Large Steel Castings for Heavy Duty. Basic electric furnaces with capacity over 25 tons and with induction stirring are used for alloy steels. A Cr-Mo-V analysis similar to Type 316 has been widely used for high-temperature service, and 13% Cr steel is favored for corrosion resistance. Welding of simple shapes into complex assemblies is common practice. ***Heinz W. Balster.*** *Metal Progress,* v. 79, no. 1, Jan. 1961, p. 89-93.

Magnesium Castings in Europe. Pressure die casting in water cooled molds gives sound parts of excellent surface at high-production rates. Other manufacturing advantages make them competitive with Al where weight or inertia are important considerations. ***E. Sayles.*** *Metal Progress,* v. 79, no. 1, Jan. 1961, p. 97-100.

* **Some Aspects of the Melting of Scrap Steel in the Cupola Furnace.** The C content of cast iron which cannot be perfectly overheated was maintained higher than 2.9%. Due to the limitation of the carbonization process in an acid cold air cupola furnace (2.7-2.9%) the steel percentage to be added was restricted to 70%. The total shrinkage of cast iron increases during its preparation with higher scrap steel percentages in the cold charge. Inoculation is very favorable with high steel percentages. (*In Dutch.*) Enige aspecten van het smelten van staalschroot in der koepeloven. ***J. Gaertman.*** *Metalen,* v. 15, no. 24, Dec. 31, 1960, p. 418-426.

* **Lightweight Cellular Metal.** A process for the production of cellular metals is described. The process consists of preparing a refractory mold, filling the mold with soluble granules which correspond to the size and shape of the pores desired in the metal and infiltrating the molten metal into this soluble aggregate. After leaching with a suitable solvent, the metal has a void structure of interconnecting cells which correspond to the shape and size of the soluble aggregate. The apparent density of the metal body can be controlled from a maximum of approximately one-third of its base density to some lower density in the order of one-fifth the base density. ***L. Polonsky, S. Lipson, and H. Markus.*** *Modern Castings,* v. 39, Feb. 1961, p. 57-71.

* **Modernization Slashes Costs, Castings Replace Stampings.** Sealed Power Corp. is mass-producing thin-walled castings in green sand. Savings from new equipment and techniques will pay for $425,000 investment in 4½ years. Much of the cut in production costs is made possible by special facilities which have drastically reduced machining expenses. ***John VanHaver.*** *Modern Castings,* v. 39, Feb. 1961, p. 44-47.

* **"Cloud Nine"—Permanent Mold Casting of Steel.** Translation of Russian paper establishing the optimum mold composition, wall thickness, ribbing practice, and heat treatments to achieve best service life when casting steel into steel permanent molds. ***S. I. Smolensky, et al.*** *Modern Castings,* v. 39, Feb. 1961, p. 40-43.

* **New Sand Practices Produce Five-Way Profits.** Describes use of sand mix containing olivine flour, silica sand and an air-setting binder. ***W. D. McMillan.*** *Modern Castings,* v. 39, Feb. 1961, p. 33-35.

* **Hot Core Box Design and Engineering.** A description of equipment and production processes dealing with the use of faster setting binders composed of various combinations of urea and formaldehydefurfural and single stage phenolic resins. Of prime importance in this process is good sand control. The proper measurement of ingredients and timing of their addition during controlled mulling cycle, plus care in sand handling to the machine help make a uniform product on the machine. The hot core box process seems to offer advantages as increased productivity and material cost reduction. ***E. E. Harkess.*** *Modern Castings*, v. 39, Feb. 1961, p. 115-120.

* **Aircraft—Missile Steel Castings. Challenge or Compromise.** The system of good steel casting designs is a necessary engineering approach to obtain good castability characteristics and equal stress distribution while in application. ***S. A. McCarthy.*** *Modern Castings*, v. 39, Feb. 1961, p. 110-114.

* **Pouring of Grey Iron Cylinder Liners in Rotating Mould.** The analysis of crystallization conditions and of the further cooling of casting shows that pouring in rotating mold is a method guaranteeing the production of sound castings of required quality. It is convenient to pour castings of plain liners and of little shape liners in hot metallic molds or in sand molds made in pouring machine. Castings of heavily shaped liners are suitably poured in sand molds made outside the pouring machine. (*In Czech.*) Odlévání vložek válců ze šedé litiny do rotující formy. ***Jiří Ptáčník.*** *Slévárenství*, v. 8, no. 12, Dec. 1960, p. 419-427.

METALS—HEAT TREATMENT

* **Effect of Composition of Quenching Media on the Temperability and Hardness of Carbon Steel.** Effect of quenching in various aqueous solutions of salts and alkalis. Work to develop a solution with optimum properties. ***Yu. A. Geller and S. D. Vais.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 30-32.

* **Isothermic Quenching and Its Applications.** The isothermic transformation of a Ni-Cr-Mo steel with an average C content and 2.5% Ni, austenized during 30 min at 835 C was studied. Different stages of lower bainite formation were displayed for a steel isothermally transformed at 340 C and containing 0.40 C, 0.3 Si, 0.6 Mn, 2.5 Ni, 0.6 Cr and 0.55 Mo. An isothermal quenching furnace is described with description of martempering, interrupted-quenching and time-quenching processes. (*In French.*) La trempe isotherme et ses applications. *Metallurgie et la Construction Mecanique*, v. 92, Dec. 1960, p. 1013-1021.

* **Investigation of the Thermal Treatment of Iron-Aluminum Magnetically Soft Alloys.** The effects of the temperature and medium of hardening on the magnetic properties of the alloy IU 16 after two annealing temperatures were studied and the conditions of thermal treatment producing high μ_0 and μ_{max} values and low H_c values in hot-rolled IU 16 sheets 0.35x600x1200 mm in size were determined. (*In Russian.*) Issledovanie termicheskoĭ obrabotki zhelezoaliuminievykh magnitnomiagkikh splavov. ***G. V. Krasnoperov and N. I. Lapkin.*** *Fizika Metallov i Metallovedenie*, v. 10, no. 5, Nov. 1960, p. 668-671.

The Influence of Impurities on the Annealing of Nickel After Cold Work. Measurements of stored energy and of changes in electrical resistivity and density accompanying annealing have been made on Ni of 99.85% purity deformed in torsion and compression. There are notable differences from the behavior found previously for Ni 99.6% purity. The results suggest that, in the purer Ni, little or no recovery involving dislocations occurs between room temperature and the recrystallization temperature, in contrast to previous results for 99.6% pure Ni. There appear to be two stages of annealing prior to recrystallization in the 99.85% material although they are not clearly resolved. These are centered at 120 C and 260 C and are tentatively ascribed to the annealing of interstitials and vacancies respectively. On this basis the observed changes in resistivity and density can be explained. ***L. M. Clarebrough, M. E. Hargreaves, M. H. Loretto, and G. W. West.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 797-803.

Dispersion Hardening. The increase in yield strength of solid Hg due to dispersed iron particles is experimentally determined to be proportional to $d/(\Lambda - d)$[1] and therefore a function only of d/Λ, where d is the particle diameter and Λ is the spacing between centers of the particles. Since d/Λ is proportional to $f^1/^2$, where f is the volume fraction of precipitate, these results show that the yield strength is a function only of the volume fraction of precipitate. In the case of coherent particles, the stressed region through which dislocations will not pass must be included. An investigation of the temperature dependence of the yield strength shows that the increase in yield strength at any absolute temperature T is proportional to $d(T_m - T)/(\Lambda - d)$, where T_m is the melting point of the Hg matrix. ***W. H. Meiklejohn and R. E. Skoda.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 773-780.

Residual Stresses Set Up in Surface Hardening. Method of approximate calculation of quenching stresses in plates with allowance for transformations and plastic deformations. ***V. V. Abramov.*** *Henry Brutcher Translation No.* 4445, 11 pp. (From *Metallovedenie i Obrabotka Metallov*, no. 12, Dec. 1958, p. 21-28.) Henry Brutcher, Altadena, Calif.

Controlled Atmospheres for Heat Treating Furnaces. Reviews recent achievements in the theoretical research and practical application of controlled atmospheres for heat-treating furnaces. Special attention is paid to exothermic atmospheres which are being gradually introduced in Czechoslovakia as well as to endothermic ones which are in the first stage of application. Engineers in charge of hardening operations will learn much from the article about modern technology and equipment. (*In Czech.*) Použití řízených atmosfér ve strojírenských závodech. ***I. Šála.*** *Strojírenství*, v. 10, no. 12, Dec. 1960, p. 950-952.

New Carburizing Steels in German Automobiles. Comprehensive research into the nature of case hardenability has led to the development of carburizing steels in which the major alloying element is Mo. These new steels have been successful to the point where they have replaced standard carburizing grades in German automobiles despite their higher cost. ***H. U. Meyer.*** *Metal Progress*, v. 79, no. 1, Jan. 1961, p. 70-75.

* **Study on the Tempering of Quenched High Speed Steels.** After tempering quenched high speed steels by continuous heating either in the differential dilatometer or in the thermomagnetometer, it was found that above 500 C. four stages exist; the first and third stages correspond to an expansion and an increase in magnetism; the second and fourth stages to a contraction. The first expansion is attributed to a $\gamma \rightarrow \alpha$ transformation at the austenite-martensite interface. This interpretation seems to be confirmed by differential thermal analysis. The importance of these special features depends on the composition of the matrix obtained by austenitization. (*In French.*) Étude des revenus des aciers à coupe rapide trempés. ***J. Papier, G. Pomey, and A. H. Michel.*** *Revue de Métallurgie, Mémoires Scientifiques*, v. 57, no. 11, Nov. 1960, p. 829-844.

* **Electric Bell Furnaces for Heat-Treating Stainless Steels.** Description and operating characteristics. *Wild-Barfield Heat Treatment Journal*, v. 7, no. 57, Dec. 1960, p. 10-12.

Surface Hardening of Steels. II. Material Selection. ***Lester F. Spencer.*** *Machine Design*, v. 33, Feb. 2, 1961, p. 110-114.

METALS—MECHANICAL AND PHYSICAL PROPERTIES

The High-Strength Steels—What They Offer. Brings newer compositions into perspective. Gives comparison table for quick reference. ***Herbert L. Kee.*** *Product Engineering*, v. 32, no. 4, Jan. 23, 1961, p. 54-61.

* **Improving the Mechanical Properties of Spring Steel.** Effect of isothermal quench hardening on structure and mechanical properties of 65G steel. ***A. V. Semichastnaya.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 32-34.

Some Effects of Heat-Treatment Upon the Impact-Fatigue Life of Ni-Hard Grinding Balls. Improvements in life were found to be related to changes observed in the microstructure of the primary phase; a theory is derived to explain the various results obtained. ***R. H. T. Dixon.*** *Iron and Steel Institute, Journal*, v. 197, pt. 1, Jan. 1961, p. 40-48.

Microstructural Causes of Heat-Affected Zone Cracking in Heavy Section 18-12-Nb Austenitic Stainless Steel Welded Joints. An electron microscope study of test specimens was made and the marked changes in hot ductility are explained in terms of temperature and strain-induced microstructural changes. The microstructural changes causing embrittlement with the 18-12-Nb steel were not observed on comparative tests with a steel of the 17-11-Mo type. ***N. E. Moore and J. A. Griffiths.*** *Iron and Steel Institute, Journal*, v. 197, pt. 1, Jan. 1961, p. 29-39.

Magnetoresistance of High Purity InSb in the Quantum Limit. The results are in qualitative agreement with theory for the quantum limit for the case of piezoelectric scattering and classical statistics. Collision broadening seems to be the mechanism preventing the resistivity in a transverse field from diverging. ***R. J. Sladek.*** *Physics and Chemistry of Solids*, v. 16, nos. 1-2, Nov. 1960, p. 1-9.

Exchange Anisotropy in Alloys of Composition (Ni, Fe)$_3$Mn. Disordered face-centered cubic alloys in which the Ni in the composition Ni_3Mn is partially replaced by Fe were studied magnetically at 4.2-750 K. When cooled to 4.2 K in a magnetic field the alloys of less than about 50 at.% Fe exhibit hysteresis loops that are displaced from their symmetrical positions about the origin, as previously reported for the Ni_3Mn. At higher Fe concentrations this exchange anisotropy behavior disappears, and the temperature and field dependences of magnetization become those characteristic of a simple antiferromagnet. This information, together with paramagnetic susceptibility data, suggest that while the Fe-Ni exchange coupling is strongly ferromagnetic, both the Fe-Mn and Fe-Fe interactions are antiferromagnetic in this alloy system. ***J. S. Kouvel.*** *Physics and Chemistry of Solids*, v. 16, nos. 1-2, Nov. 1960, p. 152-157.

Temperature and Composition Dependence of the Elastic Constants of Dilute Alloys of Manganese in Copper. Three measured moduli show temperature dependences similar to those of pure Cu. They all exhibited a linear decrease with increasing Mn concentration. The variation of the Debye temperature which was calculated from the 4.2 K values of the elastic constants was found to be about -0.6 K/at.% Mn. This implies an increase in the lattice specific heat within the "T^3" temperature region of about 0.5% per at.% Mn. The composition dependence of the shear moduli indicates that the charge of the Mn ion in the Cu lattice is $+3e$. Since it has been found from magnetic and specific heat measurements that the spin of the ion is $s = 4/2$, it is concluded that there are four $3d$ electrons remaining on the Mn ion with parallel aligned spins. ***D. L. Waldorf.*** *Physics and Chemistry of Solids*, v. 16, nos. 1-2, Nov. 1960, p. 90-99.

Exchange Anisotropy in Cobalt-Manganese Alloys. Magnetization measurements between 4.2 and 750 K on Co-Mn alloys of about 25, 30 and 35 at.% Mn indicate that no simple disappearance of ferromagnetism takes place with increasing Mn concentration, although the magnetic properties of these alloys are very sensitively dependent on composition. ***J. S. Kouvel.*** *Physics and Chemistry of Solids*, v. 16, nos. 1-2, Nov. 1960, p. 107-114.

* **Effects of Normalizing Temperature on the Mechanical Properties of Structural Steels With a Titanium Addition.** The most suitable annealing temperature, determined from comparison of mechanical properties with microstructure, is 900-950 C. There is no need to fear the superheating process up to 1000 C. Only at 1050 C is there a sharp decrease of notch toughness with considerable increase of grain size. Steel with 0.1 to 0.2% Ti cannot be welded without a thermal treatment after rolling. (*In Czech.*) Vliv normalizační teploty na hodnoty mechanických vlastností konstrukčních ocelí s přísadou titanu. ***Olga Bohušová.*** *Hutník*, v. 10, no. 12, Dec. 1960, p. 465-467.

The Effects of Surface Condition on the Mechanical Properties of Lithium Fluoride Crystals. A comparative study was made of the mechanical behavior of as-cleaved, chemically

polished and coated lithium fluoride crystals. Surface coatings were produced by vacuum deposition and by chemical reaction. Thin ($> 10\mu$) reacted-coatings increased the yield stress some 50% and were responsible for catastrophic stress drops observed at the critical resolved shear stress. Coatings also decreased the initial rate of work-hardening and the stress and strain to fracture. Failure occurred by the formation of Stroh-type cracks. An explanation for these and other results is offered based on considerations of the distribution and number of operable dislocation sources, and the piling up of dislocations at intersecting slip bands and beneath surface films. ***A. R. C. Westwood.*** *Philosophical Magazine*, v. 5, ser. 8, Oct. 1960, p. 981-990.

Electron Microscope Observations of Deformed Magnesium Oxide. Observations were made by electron transmission microscopy of thin flakes of deformed magnesium oxide. The ease of cross slip of screw dislocations in this material was directly verified. Cross slip leads to the formation of many markedly elongated prismatic loops of dislocation. These are observed profusely within slip bands, produced at room temperature. They are unstable at higher temperatures and break up into numbers of smaller prismatic loops. From these observations a mechanism for the widening of slip bands, observed under the optical microscope, is proposed. Certain dislocation interactions were observed and analyzed and preliminary observations made of slip band intersections. ***J. Washburn, G. W. Groves, A. Kelly, and G. K. Williamson.*** *Philosophical Magazine*, v. 5, ser. 8, Oct. 1960, p. 991-999.

Radiation Hardening of Copper Single Crystals. Effect of radiation on the mechanical properties of Cu was studied. Yield stress, which is substantially increased by the radiation, increases as the cube root of the flux. Annealing kinetics of the radiation hardness were also studied in the temperature range from 25 to 700 K. ***T. H. Blewitt, R. R. Coltman, R. E. Jamison, and J. K. Redman.*** *Journal of Nuclear Materials*, v. 2, no. 4, Dec. 1960, p. 277-298.

A Method Suitable for the Measurement of the Thermal Diffusivity of Irradiated Materials. Time taken for the measurement is short and some of the difficulties normally encountered in handling and machining radioactive material, prior to such a measurement, are avoided. The theory is developed, a prototype test equipment described and results quoted for brass, steel, natural U (unirradiated), Cu, and Al. ***D. Smart.*** *Journal of Nuclear Materials*, v. 2, no. 4, Dec. 1960, p. 341-349.

* **A Review of Pull- and Torsion-Tests on Cast Iron.** Theoretical analysis of shear, tensile, and torsion stresses. ***Akimasa Ono.*** *Japan Academy, Proceedings*, v. 36, no. 9, Nov. 1960, p. 601-606.

* **The Hydrides of Palladium and Palladium Alloys.** Changes in structure and physical properties of Pd following absorption of H. ***F. A. Lewis.*** *Platinum Metals Review*, v. 5, no. 1, Jan. 1961, p. 21-25.

* **The Theory of Deformation in the Light of Physical Metallurgy.** Discussion of strip rolling. (*In German.*) Verformungstheorie aus der Sicht der Metallphysik. ***Hein-Peter Stüwe.*** *Stahl und Eisen*, v. 80, no. 26, Dec. 22, 1960, p. 1963-1969.

The Work Hardening of Metals. Survey of the theory limited primarily to face-centered cubic metals. ***N. F. Mott.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 962-968.

Prediction of Fatigue Life. On the basis of the relation between the "reliability-function" and the "risk" of failure (as a function of age), the physical interpretation of the latter can be used to extrapolate the former beyond the range of possible observation. It is shown that the asymptotic distribution of smallest values is compatible with the physical concept of (dynamic or static) fatigue, while the logarithmic-normal distribution is not. ***A. M. Freudenthal.*** *Journal of Applied Physics*, v. 31, Dec. 1960, p. 2196-2198.

* **A Magnetic Susceptibility Balance and the Temperature Dependence of the Magnetic Susceptibility of Copper, Silver, and Gold, 295°-975°K.** A magnetic susceptibility balance is described which has a reproducibility of better than $\pm 0.15\%$.

The temperature dependence of the magnetic susceptibility of Cu, Ag, and Au from 295 to 975 K is reported. ***M. Garber, W. G. Henry, and H. G. Hoeve.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1595-1613.

* **Fatigue Characteristics of EC and 5005 Alloy Aluminum Wire.** ***C. E. Burley.*** *Power Apparatus and Systems*, 1960, no. 51, Dec., p. 789-792.

Physical and Mechanical Properties of the Cobalt-Chromium-Tungsten Alloy WI-52. Includes applications, specifications and nomenclature, fabrication, oxidation resistance, hardness, and stress-rupture and creep properties. ***F. R. Morral and H. J. Wagner.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 66, Sept. 22, 19 pp. (TN799 B32.2d Contin.)

Some Physical Properties of Martensitic Stainless Steels. Surveys Types 403, 410, 414, 416, 420, 422, 431, 440, and USS 12 MoV. Includes data on chemical composition; density; melting point range; specific heat; magnetic, thermal, and electrical characteristics; Poisson's ratio; and moduli of elasticity and rigidity. ***J. G. Hoag and D. B. Roach.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 68, Sept. 28, 1960, 30 pp. (TN799 B32.2d Contin.)

Microwave Faraday Effect in Silicon and Germanium. Rotation measurements on *n*- and *p*-type single crystals of Si at room temperature, with resistivities from 0.5 to 40 ohm-cm, utilizing 9.6- and 35-kMc/sec radiation, are compared with the theory. Results for *n*-type Ge at 78 K, with μB varied up to about 6, agree with the calculated low- and high-field behavior. Faraday ellipticity measurements on *n*-type Ge crystals at 78 K are in qualitative agreement with the theory. ***J. K. Furdnya and S. Broersma.*** *Physical Review*, v. 120, 2nd ser., no. 6, Dec. 15, 1960, p. 1995-2003.

Availability and Mechanical Properties of High-Strength Steel Extrusions. Six classifications of high-strength steels are considered. Typical current extrusion specifications are discussed, and illustrative mechanical properties are reported. Some attention is devoted to anticipated future consumer requirements. ***R. J. Fiorentino and A. M. Sabroff.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Report No.* 138, Oct. 26, 1960, 60 pp. (TN799.T5 B32.7t Vis.)

* **The Critical Field of Superconducting Aluminum Under Pressure.** The effect of pressure on the critical field of Al was measured between 0.3 K and the transition temperature. Pressures up to about 1,700 atm were made by the ice-bomb technique. ***D. Gross and J. L. Olsen.*** *Cryogenics*, v. 1, no. 2, Dec. 1960, p. 91-95.

Contribution of Dislocation Line Tension and the Density of the Solute Atmosphere to the Yield Point in Strain Aged Ingot Iron. An investigation was made of the 77 K yielding behavior of ingot iron specimens that had been prestrained and aged while under stress at 303 K. It was observed that the presence of a yield point at 303 K after a strain aging treatment does not result in a yield point at 77 K until the strain aging treatment is prolonged so as to result in an increase in the 303 K yield point of about 20%. The sharpness and magnitude of the yield point at both 303 K and 77 K increased with an increase in the aging time and/or an increase in the stress which was maintained upon the specimen during the aging treatment. The observations of the effect of the aging time and aging stress are discussed in terms of the contribution of the dislocation line tension and solute atmosphere density along the dislocation. ***T. Mura and J. O. Brittain.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 767-772.

* **Statistical Approach to the Creep Problems.** Shows that despite the best possible understanding of the physical nature of creep, the results of calculations cannot be accurate and reliable, as the effect of random deviations is too strong. (*In Czech.*) Statistické hodnocení tečení materiálu za vyšších teplot. ***J. Sedláček*** *Strojírenství*, v. 10, no. 12, Dec. 1960, p. 895-900.

On the Effective Surface Energy Involved in the Brittle Fracture of 70/30 Brass. A 70/30 brass wetted with Hg fails at about the engineering yield stress in a brittle manner. The degree of embrittlement is temperature dependent, showing an abrupt reversion to the fully ductile state in the manner of the transition displayed by body-centered cubic metals. The effective surface energy associated with this brittle fracture has been analyzed from experimental measurement of σ_F vs $d^{-1/2}$ and σ_F vs C (crack length). In both cases, the evidence is that the effective surface energy is less than 10^3 ergs/cm^2. ***H. Nichols and W. Rostoker.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 788-790.

Effect of Low Temperatures Upon Fracture and Toughness of [Medium Alloy] Steel. Effect of high quenching temperatures and various fourth alloying elements in Ni-Cr-Mn steels. ***M. P. Braun.*** *Henry Brutcher Translation No.* 4854, 8 pp. (From *Izvest. Akad. Nauk SSSR, OTN, Met. i Topl.*, 1960, no. 2, p. 104-109.) Henry Brutcher, Altadena, Calif.

METALS—MECHANICAL WORKING

* **Shaving of Corrected Helical Gears.** Methods for determining the magnitude of correction of a gear being shaved to avoid any change in its helix angle. ***N. P. Sitalov.*** *Machines and Tooling* (Translation of *Stanki i Instrument*). v. 31, no. 8, Aug. 1960, p. 20-24.

* **Running-In and Force Testing of Machine Tools Without Metal Cutting.** Describes test instruments. ***V. F. Paramonov.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 15-17.

* **Determining the Fields of Application of Various Machining Methods.** Method developed at ENIMS for comparative generalized analysis. ***A. O. Étin.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 11-15.

* **Fixing Ceramic Cutting Tips With Heat and Vibration Resisting Adhesive.** Tests of adhesives based on phenol-rubber compositions and those based on ED-6 epoxide resin, cold and hot setting. ***A. V. Rudnev and V. V. Sokolovskaya.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 37-38.

* **Problems Connected With the Manufacture and Estimation of Quality of Aluminum Sheets for Deep-Drawing.** (*In German.*) Probleme der Herstellung und Gütebeurteilung von tiefziehbaren Aluminiumblechen. ***Karl-Robert Vassel.*** *Neue Hütte*, v. 5, Nov. 1960, p. 652-655.

* **An Introduction to the Theory and Practice of Flat Rolling. V.** Analyzes forces in various parts of the rolling mill. ***C. W. Starling.*** *Sheet Metal Industries*, v. 38, Jan. 1961, p. 49-55.

* **Economical Use of Cold-Forged Components.** Typical series of operations for the production of different types of components, with particular reference to the "Colforg" method. ***H. D. Feldmann.*** *Sheet Metal Industries*, v. 38, Jan. 1961, p. 8-13.

Extrusion of Hard Alloys. Developments in the working of high Ni-containing materials. ***A. B. Graham.*** *Metal Industry*, v. 97, Dec. 23, 1960, p. 521-524.

* **Hobbing Hardened Gears.** Machining tests to investigate the possibility of substituting hobbing for grinding gears with hardness of R_c 56 or higher. ***Yu. I. Retivykh.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 8, Aug. 1960, p. 24-27.

* **The Differential Double-Deck Wire Drawing Machine.** Construction and method of operation. ***F. Liekmeier.*** *Wire*, no. 50, Dec. 1960, p. 238-241.

* **The New German Standards on Surface Roughness and Their Effects on Surface Measurement.** Explanation of standards DIN 4760, DIN 4762 and DIN 4763. (*In German.*) Die neuen deutschen Oberflächennormen und ihre Auswirkungen auf die Oberflächenmessung. ***Herbert v. Weingraber.*** *Stahl und Eisen*, v. 80, no. 26, Dec. 22, 1960, p. 1933-1939.

* **Applying Color Metallography to the Study of Occurrences Connected With the Manufacture of Low-Carbon Deep-Drawing Steel Sheets.** (*In Italian.*) Applicazione della

metallografia a colori allo studio dei fenomeni connessi con la fabbricazione delle lamiere in acciaio dolce destinate al profondo stampaggio. ***G. Odone and V. Berruti.*** *Metallurgia Italiana*, v. 52, Nov. 1960, p. 716-720.

* **The Fundamentals of Wire Drawing. VI. Profile of a Drawing Wire.** ***C. P. Bernhoeft.*** *Wire Industry*, v. 27, Dec. 1960, p. 1197 + 2 pages.

* **Basic Features of the Cold Forging Process.** An introduction to the basic features of the process providing some information on the elements of design. ***A. M. Cooper.*** *Wire Industry*, v. 27, Dec. 1960, p. 1189 + 4 pages.

* **Materials for Press Tools.** Discusses epoxy resins, zinc-base alloys, aluminum bronzes, and tool steels. ***A. G. Shaw.*** *Sheet Metal Industries*, v. 38, Jan. 1961, p. 43-48.

* **A Stretch-Forming Test for Use With a Variable-Speed Drawing Press.** A method of rapid testing which eliminates the necessity for stopping the punch at the exact moment of fracture. ***D. V. Wilson, B. B. Moreton, and R. D. Butler.*** *Sheet Metal Industries*, v. 38, Jan. 1961, p. 25 + 12 pages.

* **Experiences in the Industrial Production and Use of Cold-Extruded Steel Components.** Deals with component choice and design, design of pressing stages and tooling, choice of steel for cold extrusion, preparatory treatments, and use of cold-extruded parts. ***R. E. Okell.*** *Sheet Metal Industries*, v. 38, Jan. 1961, p. 14-20.

* **Speed Control Devices for Metal Pipe and Extrusion Presses.** The extrusion speed of an extrusion press can be adjusted by a controller driven by a hydraulic accumulator. With such a design the extrusion speed is adjustable also during an isothermal extrusion process. Discusses how the production rate of an extrusion press can be increased by this new and sensitive controller. (*In German.*) Geschwindigkeitsregeleinrichtungen für Metallrohr- und Strangpressen. ***Hans-Joachim Pahnke.*** *Zeitschrift für Metallkunde*, v. 51, Dec. 1960, p. 671-673.

METALS—METALLOGRAPHY, TRANSFORMATIONS, AND STRUCTURES

Hydrogen in Zircaloy-2: Its Distribution and Heat of Transport. Two determinations of the heat of transport were made under steady-state conditions over the temperature range 300 to 500 C. Values of 4.7 and 6.1 kcal/mole were obtained. Similar experiments on deuterium gave values of 6.2 and 6.8 kcal/mole. An equation was developed giving the H concentration in the two-phase (alpha plus hydride) region as a function of time and temperature. ***A. Sawatzky.*** *Journal of Nuclear Materials*, v. 2, no. 4, Dec. 1960, p. 321-328.

On the Location and Motion of Rare Gas Atoms in Metals. Using potentials of about 40 kV, rare gas ions were accelerated into metal films and foils. In spite of the fact that as much as 2 at.% Ar was loaded into the metal lattice, little or no X-ray effect due to lattice distortion was observed. This result suggests that rare gas atoms coming to rest in a metal lattice capture vacancies. ***C. W. Tucker, Jr. and F. J. Norton.*** *Journal of Nuclear Materials*, v. 2, no. 4, Dec. 1960, p. 329-334.

* **Diffusion of Tin, Zinc and Cobalt in Single Crystals and Polycrystals of Tin.** By means of "integral remainder" method and applying radioactive ^{123}Sn, ^{65}Zn, ^{60}Co isotopes, the diffusion coefficients in temperature interval of 140 C to 217 C were measured. The dependence of diffusion coefficients and temperature for mono- crystalline samples was obtained in form: $D_{Sn} = 9.9 \cdot 10^{-4}$ exp (-10800/RT), $D_{Zn} = 9.8 \cdot 10^{-4}$ exp (-7800/RT), $D_{Co} = 5.5$ exp (-22000/RT). (*In Polish.*) Dyfuzja cyny, cynku i kobaltu w mono- i polikryształach cyny. ***Władysław Chomka and Józef Andruszkiewicz.*** *Nukleonika*, v. 5, no. 10, 1960, p. 611-615.

Pitting of Aluminium at Grain Boundaries After Ageing. Thin foils of 99.999% aluminum prepared by electropolishing have been found to develop surface pits along the grain boundaries during aging at room temperature. It is suggested that the pits are formed by a vacancy mechanism, and that they are associated with the initiation of etch attack along the grain boundaries of aged pure Al. ***G. A. Bassett and C. Edeleanu.*** *Philosophical Magazine*, v. 5, ser. 8, Dec. 1960, p. 1217-1220.

Measurement of the Debye-Waller Temperature Factor for Silver and α-iron. Measurements have been made of the variations with temperature of the intensities of X-ray diffraction lines from Ag and Fe. For Ag the measurements were in the range 286-1100 K, and the Debye-Waller temperature factor corresponded to a characteristic temperature of 197 K at 286 K. For Fe the measurements covered the range 286-1190 K, and corresponded to $\Theta = 389$ K, although there was a large scatter in the results due to crystal changes brought about by annealing. The intensity measurements showed no discontinuity at the Curie temperature, nor was there any anomaly in the spacing of the (110) planes. ***C. W. Haworth.*** *Philosophical Magazine*, v. 5, ser. 8, Dec. 1960, p. 1229-1234.

Metallography at Liquid Helium Temperatures.** An apparatus was designed for the microscopic examination of metals at liquid He temperatures and it has been used to study the martensitic transformations which occur in Li and Na. At 20 K between 40 and 50% of the large grained specimens of Na were transformed to the new phase and no further change was observed on cooling to 6 K. For small-grained specimens the amount of transformation was much less. For Li nearly the whole of the specimen had transformed to the new phase at 20 K. Transformation started at 31 K for Na and at approximately 76 K for Li. ***D. Hull and H. M. Rosenberg. *Cryogenics*, v. 1, no. 1, Sept. 1960, p. 27-32.

* **Studies of Transformations of Austenite in Low-Carbon Bainitic Steels During Continuous Cooling.** Kinetics of transformations of austenite during continuous cooling was studied in low-carbon Cr-Mo, Cr-Ni-Mo, Mn-Cr-Mo, and Mn-Cr-Ni-Mo steels with or without additions of boron. Both dilatometric (Constant's ADAMEL apparatus) and metallographic methods were used. Cooling rates ranged from water quench to 45 C/h. Transformation curves of continuously cooled austenite were plotted in log time-temperature diagrams. A concept of "half-way cooling time" was used in the interpretation of the results. The values of critical halfway cooling time corresponding to the appearance of ferritic/pearlitic transformation and disappearance of bainitic transformation were determined. (*In Czech.*) Badania przemian przechłodzonego austenitu w niskowęglowych stalach bainitycznych podczas chłodzenia ciągłego. ***W. Ciaś.*** *Prace Instytutów Hutniczych*, 1960, no. 12, p. 223-237.

An Electron Microscopical Investigation of the Tempering of 18-4-1 High-Speed Steel. An electron microscopical examination was made of the structures which occur during the tempering of 18-4-1 high-speed steel. The secondary hardening phenomenon is shown to arise from the precipitation of an alloy carbide ($M_{22}C_6$ type) in the martensitic needles. A similar precipitation observed in the retained austenite does not appear to contribute to the hardening process. ***C. H. White and R. W. K. Honeycombe.*** *Iron and Steel Institute, Journal*, v. 197, pt. 1, Jan. 1961, p. 21-28.

The Carbide Constitution and Tempering Behaviour of Chromium-Vanadium-Niobium Steels at 700°C. The carbide constitution and tempering characteristics of chrome-vanadium steels containing 0.2% and 1.0% Nb were determined. It is suggested that the Nb additions reduce the C available for combination with Fe, Cr, and V and these changes in the effective C content caused the observed movement of the carbide phase boundaries. ***K. C. Mills, B. B. Argent, and A. G. Quarrell.*** *Iron and Steel Institute, Journal*, v. 197, pt. 1, Jan. 1961, p. 9-21.

* **Titanium-Hydrogen System.** A chemically pure Ti powder can absorb 465.5 ml H for 1 g Ti, which corresponds to the stoichiometrical formula TiH_2. Titanium hydride with the formula TiH_2 is formed at 400 C and at 10 mm of the Hg column for H. The impurities in the Ti powder delay the formation of the hydride. Small amounts of Ni and O render this hydride unstable at temperatures above 500 C. (*In Russian.*) Sistema Titan-Vodorod. ***S. P. Grodzov and A. A. Zhurenkova.*** *Izvestiia Vysshikh Uchebnykh Zavedenii, Chernaia Metallurgiia*, 1960, no. 9, p. 8-13.

* **The Crystal Structure of Zr_2Al.** ***C. G. Wilson and D. Sams.*** *Acta Crystallographica*, v. 14, pt. 1, Jan. 10, 1961, p. 71-72.

*** Work-Hardening and Stacking Fault Energy of Copper-Alloy Crystals.** The work-hardening of single crystals of Cu-Ga and Cu-Ge has been investigated as a function of concentration, temperature, and strain rate. The alloys have been chosen in the α-(fcc)-solid solution approaching the hexagonal ζ-phase. As expected, the stacking fault energy, measured by the stress at the beginning of cross slip, decreases rapidly with increasing concentration. Deformation twinning is observed up to 200 C in the concentrated alloys. (*In German.*) Verfestigung und Stapelfehlerenergie von Kupfer-Legierungskristallen. ***Peter Haasen and Alwyn King.*** *Zeitschrift für Metallkunde*, v. 51, Dec. 1960, p. 722-736.

*** Methods to Display the Gamma Grain. Determination of the Gamma Grain by Condensation of an Alloy Able to Be Syncrystallized.** A new method was described which introduces no foreign elements that could segregate in the gamma grain boundaries, so that the grain growth aptitude is not affected. Very soft Ni-Cr steel and very hard Cr steel were tested. The austenizing conditions were defined with precision by heating in high vacuum. The determination of the gamma structure was almost instantaneous and independent of the thermal cycle chosen. (*In French.*) Méthodes de mise en évidence du grain gamma. Détermination du grain gamma par condensation d'alliage syncristallisable. ***G. Vigneron.*** *Métaux Corrosion-Industries*, v. 35, Dec. 1960, p. 439-454.

The Diffusivity of Hydrogen in Alpha Iron. Diffusivity was determined at 25 to 780 C from H evolution rates. ***E. W. Johnson and M. L. Hill.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1104-1112.

The Effect of Dilute Transition Element Additions on the Recrystallization of Iron. All these elements immediately raised the temperature, the majority having their greatest effect in less than 0.10 at.%. A correlation is noted between the rate of change of recrystallization temperature with at.% solute and the electron configuration of the solute element. ***E. P. Abrahamson, II and B. S. Blakeney, Jr.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1101-1104.

The Growth Rate of Bainite. The growth rate is independent of time at constant temperature, but both the edgewise and sidewise growth rates increase with increasing temperature. Increasing the C content, or adding Cr or Ni, decreases the growth rate without greatly affecting the temperature dependence. ***G. R. Speich and Morris Cohen.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1050-1059.

The Aging Characteristics of Cu-Ti. The aging behavior of a Cu-Ti (3.2 at.% Ti) alloy was followed by electrical resistivity, hardness, and metallographic changes. The resistivity data indicate two principal processes, the first causing a sharp decrease in resistivity, and the second, which occurs over a long period of time, a much smaller rate of decrease. ***G. T. Murray.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1059-1064.

A Metallographic Study of Precipitation of Copper From Alpha Iron. Copper precipitates from α iron as *fcc* ε phase without formation of intermediate compounds. In the first stage of the precipitation, spherical particles with diameters <100 Å are formed at a high rate. During the second stage, the particles grow at a rate given by Zener's equation for growth of a spherical precipitate. In the third stage, growth is slower. ***E. Hornbogen and R. C. Glenn.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1064-1070.

Diffusion in the Iron-Chromium System. The general pattern of behavior observed is not consistent with present theories of diffusion by a vacancy mechanism. Suggestions are made for further clarifying experiments. ***H. W. Paxton and T. Kunitake.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1003-1009.

A Further Study of Ti_2Ni-Type Phases Containing Titanium, Zirconium or Hafnium. The existence of 11 previously unreported isomorphs is cited and some approximate phase boundaries are given. Lattice parameters are reported for the new phases. The periodic table relationships involved in the occurrence of the phase are discussed. ***M. V. Nevitt, J. W. Downey, and R. A. Morris.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1019-1023.

Self-Diffusion in Alpha Iron. Coefficients were determined between 980 and 1167 K using Fe^{55} as the tracer. With decreasing temperature, the diffusivity was found to decrease more rapidly than predicted by the Arrhenius equation in the region of the Curie temperature. ***Richard J. Borg and C. Ernest Birchenall.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 980-984.

The Effects of Alloying Elements in Titanium. Volume A. Constitution. The available information on the constitution and structure of binary and ternary alloys of titanium is presented. Phase diagrams are presented for 37 binary titanium alloys, and partial information is presented for 14 others, as well as for 67 ternary titanium-alloy systems. ***D. J. Maykuth, H. R. Ogden, and R. I. Jaffee.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Report No.* 136A, Sept. 15, 1960, 232 pp. (TN799.T5 B32.7t Vis.)

*** Development of a New Austenitic CrMnN Steel for Castings.** In laboratory tests and tests in foundries, optimum conditions for melting and heat treating technology have been determined. (*In Czech.*) Vývoj a výzkum austenitické oceli typu CrMnN na odlitky. ***K. Löbl, A. Šustek, and K. Hýbek.*** *Strojírenství*, v. 10, no. 12, Dec. 1960, p. 907-915.

*** Cause and Formation of the Abnormal Structure in Steels.** The conditions of development of abnormal structure was studied in pure Fe melts with about 1.2%C and with individual or combined additions of Si, Mn, P, S, Al, As, Cu, N and O, as well as in ordinary unalloyed steels. The effects of cooling rage and recarburization in a charcoal barium carbonate or benzene-H mixture were examined as well as the formation of cementite and perlite. (*In German.*) Ursache und Entstehung des anomalen Gefüges in Stählen. ***Hans-Joachim Wiester, Richard Pusch, and Manfred Hoffmann.*** *Archiv für das Eisenhüttenwesen*, v. 31, no. 12, Dec. 1960, p. 731-747.

Neutron Irradiation of Gray Tin. Gray tin was irradiated at 0 C in a reactor in an effort to produce white tin as a result of localized heating caused by thermal spikes. The irradiated powder was compared to an unirradiated specimen by means of X-ray studies at low temperatures. No significant change was found in the amount of white tin present as a result of irradiation. ***A. N. Goland.*** *Physics and Chemistry of Solids*, v. 16, nos. 1-2, Nov. 1960, p. 46-52.

*** Microstructures and Notes on Carbon Steels Made to B.S.3100:1760 Grades A and B.** Many pictures of microspecimens are presented and discussed. ***J. Turton and B. H. C. Waters.*** *British Foundryman*, v. 53, Dec. 1960, p. 524-530.

*** Some Investigations on the Cerium-Treated Cast Iron.** The effects of the addition of cerium on the macro- and microstructure of hypoeutectic and eutectic cast iron were investigated and further, some experiments were carried out to produce the high strength and rapid-malleable cast iron containing high Si by the addition of cerium. ***Masao Homma, Akira Minato, Hiroshi Meguro, and Yoshihiko Abe.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 12, no. 6, Dec. 1960, p. 500-510.

The Influence of an Electric Potential Gradient on the Thermal Etching of Silver. The size of the etched facets produced on a single crystal of Ag when heated to 720 C for 150 hr in air while a direct current is passing through it, is shown to vary by a factor of about 10, depending on the polarity of the field relative to the crystal orientation. The effect does not occur in N or *in vacuo* with a direct current or in air with an alternating current. It is suggested that, due to the electric field, Ag ions on the surface migrate away from the edges of steps and therefore are more likely to evaporate. This promotes a drift of the steps across the surface in the opposite direction to the migrating ions. The presence of O is assumed to cause the

monatomic steps on the surface to aggregate and leads to the development of facets. ***E. D. Hondros and A. J. W. Moore.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 751-757.

*** Growing of Single Crystals of Zinc, Bismuth, and White Tin by the Bridgman Method.** Studies were made on the effects of various growing conditions on the yield percentage as well as orientation distribution of round-bar single crystals of Zn, Bi, and white tin as grown by the Bridgman method. In order to prepare the ingots which are to be converted into single crystal, molten Zn was poured in air or in vacuum or sucked up into soft glass tubes, and it was found that the vacuum casting is not practical and the suction casting is best. The higher the purity of the material, the greater the degree of success. ***Mikio Yamamoto and Jirô Watanabe.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 12, no. 6, Dec. 1960, p. 486-499.

*** Light Figures and Surface Structures Revealed by Chemically Etched Germanium Single Crystals.** Light figures projected on a plate screen from Ge single crystals, polished mechanically and etched with various chemical reagents, are examined in order to find out light figures or etching directions suitable for the orientation determination. Information regarding surface structures of Ge single crystals developed by mechanical polishing and by chemical etching has been obtained from the analysis of the observations. ***Mikio Yamamoto, Jirô Watanabé, and Kinji Hoshi.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 12, no. 6, Dec. 1960, p. 471-485.

A Theory of Diffusion of Impurities in Pure Silver. A new ionic model for the determination of H and D by the method used by Lazarus has been used to obtain values for period V elements in Ag with an improved agreement between calculated and observed values. With the same model, the difference in ion core size and effective nuclear charge in periods IV and VI was used to calculate values of H and D. ***J. M. Tobin.*** *Acta Metallurgica*, v. 8, Nov. 1960, p. 781-787.

On the Internal Friction of Cold-Worked and Quenched Martensitic Iron and Steel. A theoretical explanation is given for the internal friction peaks which are observed at 200~250 C for cold-worked iron and steels and for steels in the martensitic condition. The theory for the peaks is based upon the addition of a term to the free energy in order to account for the strain energy due to the interaction of an atmosphere and the line imperfections. ***T. Mura, I. Tamura, and J. O. Brittain.*** *Journal of Applied Chemistry*, v. 32, no. 1, Jan. 1961, p. 92-96.

METALS—POWDER

Purification Reactions of Tantalum During Vacuum Sintering. Purification of commercial-purity Ta powder by vacuum sintering in the temperature range 2600-2860 C was investigated. Mixtures of TaO_2 and TaC were sintered at 1800 and 2200 C. Tantalum bars containing 1% additions of O, N, and C were sintered in the range 1800 to 2600 C. Analyses were conducted on the sintered mixtures to determine the extent of removal of O, N, and C at each sintering condition. Mechanism for removal of each impurity, and the conditions necessary for preparing ductile Ta by vacuum sintering are discussed. ***W. D. Klopp, D. J. Maykuth, H. R. Ogden, and R. I. Jaffee.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 971-977.

NONDESTRUCTIVE TESTING AND QUALITY CONTROL

New X-Ray Technique Locates Core in Fuel Plates. A new technique that uses coherent X-ray scattering provides a quick production-line method for efficiently and accurately locating the uranium "meat" in clad reactor fuel plates. Since the cross section for coherent X-ray scattering depends on the cube

of the atomic number, such scattering can be used to detect large-atomic-number materials imbedded in small-atomic-number media. ***Charles A. Ziegler, J. C. McCue, J. Brinkerhoff, and D. Chleck.*** *Nucleonics*, v. 19, Jan. 1961, p. 76-78.

Resistance Apparatus for the Continuous Measurement of Fine Wire Uniformity. Highly reproducible results on clean and graphite-coated tungsten and molybdenum wires from 1 to 9.5 mil are presented. A linear relation between resistance and wire weight was obtained on clean wires, but only on those coated wires with very uniform coatings. ***A. I. Michaels, T. L. Weaver, and R. C. Nelson.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 6, Dec. 1960, p. 1070-1076.

NUCLEAR PHYSICS, NUCLEONICS, AND RADIATION

Operation and Maintenance of an In-Pile Gas-Cooled Loop at the BRR. A circulating-gas loop was operated 5574 hr in-pile at the Battelle Research Reactor to evaluate fuel materials and to obtain engineering data for the GCRE and ML-1. In the final design, 200-psig N-0.5 volume per cent O could be circulated at a rate of 1500 lb per hr through a 1.5-in.-ID by 24-in.-long instrumented test section to provide a heat-removal capacity of around 50 kw. ***Sam J. Basham and William G. Rieder.*** *U. S. Atomic Energy Commission, BMI-1485*, Dec. 14, 1960, 25 pp. (UF767 U3b Contin.)

*** Two-Body Cluster States in Nuclei.** A number of experimental results for nuclear states are cited that require a description of the nucleus as the interaction of two clusters of nucleons. The types of experiments that yield information about states of two-cluster parentage are considered. The clusters identified and discussed consist of such bodies as deuterons, excited deuterons, α-particles, tritons, helium-3, and nuclei in an excited state such as $^8Be^*$ and $^{12}C^*$. The general nature of the nuclear forces necessary to produce clustering is discussed, and a phenomenological model describing these cluster states in terms of coupled Schrödinger equations is presented. The model is compared with other current models of nuclear structure. Several definite predictions of the model for the dynamic behavior of nuclear systems are given. ***G. C. Phillips and T. A. Tombrello.*** *Nuclear Physics*, v. 19, no. 5, Nov. 1960, p. 555-578.

The Annealing of Electron Irradiation Damage in Graphite. Samples of pure artificial graphite were irradiated with electrons at 79 K, and a study made of the annealing characteristics of the changes in electrical conductivity, Hall effect and magneto-resistance. All three quantities show an anomalous annealing range below 120 K, and a simplified band theory calculation indicates that the concentration of both electrons and positive holes increase during irradiation and also in the anomalous annealing range. ***W. N. Reynolds and P. R. Goggin.*** *Philosophical Magazine*, v. 5, ser. 8, Oct. 1960, p. 1049-1058.

Coherent Radiation From the Electrons in a Synchrotron. By means of this radiation it is easy to determine the beginning of the formation of the electron condensate in the synchrotron with betatron start-up. During the inconstant distribution of electrons in the separator, the radiation can be used in measuring the frequency of the phase waves. The use of coherent radiation on the 50th harmonic in order to study the damped phase waves is possible only with distributions of wave amplitudes of the δ function type. (*In Russian.*) Kogerentnoe isluchenie elektronov v sinkhrotrone. ***Iu. M. Ado and V. V. Elian.*** *Atomnaia Energiia*, v. 9, no. 6, Dec. 1960, p. 455-460.

Radioactive Waste Disposal. This discussion considers the nature of radioactive wastes, the philosophy of their handling, the origin of wastes in the nuclear fuel cycle, waste management as it is practiced today, treatment of gaseous, solid, and liquid wastes, the question of ultimate disposal, and some estimates of what this problem may become in the future. ***Walter A. Rodger.*** *U. S. Atomic Energy Commission, ANL-6233*, Sept. 1960, 169 pp. (UF767 Un3.1an Contin.)

Electronic and Nuclear Properties of Some Radioactive Rare-Earth Elements. Ground-state nuclear spins of 13 radioactive rare earths (lanthanides) were measured by the atomic-beam magnetic-resonance method. Ground levels (J) and corresponding g values were determined for Pm, Dy, Ho, and Er. ***Amado Y. Cabezas.*** *U. S. Atomic Energy Commission, UCRL-9346,* Aug. 9, 1960, 161 pp. (UF767 U3u Contin.)

VMR Critical-Assembly Studies. The critical-assembly core consisted of 37 hexagonal, stainless steel, fuel-element cans each containing 61 fuel pins. The fuel pins were 0.485-in.-OD Al tubing (0.028-in. wall) filled with UO_2 pellets, 0.415 in. in diameter and 1.80% enriched. Fuel pins and elements were arranged in triangular lattices. Core configurations that were combinations of 0.633- and 0.703-in. pin pitches and 5.54-, 5.95-, and 6.34-in. element pitches were investigated. Light water served as the moderator, while water, furfural, furfuryl alcohol, and air were used within the fuel elements as coolant-simulating materials. In the various core configurations measurements were made of nuclear parameters related to thermal-flux disadvantage factors, resonance-escape probability, fast effects in uranium-238 and uranium-235, and effective neutron temperatures. Critical configurations, reactivity worth of liquid levels, core temperature coefficient of reactivity, and flux and power distributions were also obtained. ***Richard A. Egen, Lee H. Bettenhausen, William S. Hogan, David A. Dingee, and Joel W. Chastain.*** *U. S. Atomic Energy Commission, BMI-1482,* Dec. 2, 1960, 60 pp. (UF767 U3b Contin.)

* **Sector-Type Double Focusing Beta-Ray Spectrometer.** A new type of magnetic beta-ray spectrometer especially suitable for electron-gamma and electron-electron directional correlation experiment was constructed It is a version of an ordinary sector-type double-focusing spectrometer which accepts a large solid angle. Since the spectrometer was so designed that the wall of the vacuum chamber serves as the return circuit of magnetic flux, a scintillation counter or another spectrometer can be put in the space entirely free from magnetic field. ***M. Sakai, H. Ikegami, and T. Yamazaki.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 154-164.

* **Higher Order Chance Coincidences in a Fast-Slow Coincidence Arrangement.** In addition to the chance coincidences due to two pulses there are higher order chance coincidences which require a total of three or four pulses and whose relative contribtuions to the counting rate increase with soure strength. Formulas for these effects are given, and methods for measuring the corrections are discussed. ***Helmut Paul.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 131-136.

* **A Note on the Background in NaI Scintillation Counters.** The residual background in sodium iodide (thallium activated) crystals has been studied with the scintillation spectrometer with an anticoincidence annulus. The characteristic response of this system to gamma rays is used to identify background peaks as coming from gamma rays and not-charged particles. There are contributions from the natural radioactivity of K^{40}, the Th^{232} series, and the U^{238} series. ***S. Raboy and C. C. Traul.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 145-148.

* **Small Scattering Chamber for Large Angular Region.** Describes a small vacuum chamber for scattering of charged particles on nuclei at low and intermediate energies (<30 MeV). The chamber has an angular range of 0 to 160 and can be used without foils in front of the counters. ***H. R. E. Tjin A Djie, F. J. De Heer, and L. A. Ch. Koerts.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 172-174.

Sixth International Electronic and Nuclear Review. Scientific Congress of June 1959. Nuclear Sessions. (A-601, A-602, A-603) A collection of studies from the International Symposium on the Safety and Location of Nuclear Plants. The ambient factors are examined in the first volume, the meteorological in the second. Some topics are: observations upon the influence on public safety of underground containment in nuclear power plants; evaluation of major loss-of-coolant type accidents and design criteria for the containment of water-cooled or water-moderated reactors; burnup versus enrichment; the choice of nuclear plants in connection with the electric power supply. (*In Italian.*) VI. Rassegna internazionale elettronica e nucleare. Congresso Scientifico, Giugno 1959. Sezione Nucleare. ***Italian Nuclear Research Committee, editor.*** v. I, 582 pp.; v. II, 590 pp.; v. III, 124 pp. 1959. Plazzo dei Congressi E.U.P., Rome, Italy. (TK9006 R18a)

a **Jason Operating Experience. I.** There are about 30 Argonaut-type reactors in existence; this first article describes the approach to critical and some of the subsequent experiments on a British built modification. ***B. W. Emmerson.*** *Nuclear Power,* v. 5, Dec. 1960, p. 102-105.

b **A Technique for Observation of the Nuclear Magnetic Resonance of Some Short-Lived Nuclides and Its Application to the Measurement of the Nuclear g-Factor of Li^8.** ***Donald Connor.*** *U. S. Atomic Energy Commission, ANL-6263,* Nov. 1960, 94 pp. (UF767 Un3.1an Contin.)

c **A Pulsed Neutron Source Technique.** For a measurement of the diffusion constant D from the decay of the fundamental mode only, optimal dimensions of the pile are given, leading to a fast decay of the higher modes. Another method is discussed which makes use also of higher modes. Evaluation formulae and optimal pile dimensions for this method are derived. Finally, the amplitudes of the normal modes are calculated for different initial distributions of the neutrons by means of the Fermi age theory. ***R. Siems and M. Melissaropoulos.*** *U. S. Atomic Energy Commission, ANL-6254,* Nov. 1960, 32 pp. (UF767 Un3.1an Contin.)

d **Table of Energy Levels of Asymmetric Even Nuclei With Beta-Vibration-Rotation Interaction.** Davydov and Chaban have extended the work of Davydov and Filippov on the collective excited states of asymmetric even nuclei by including the beta-vibration-rotation interaction in an exact manner ***Paul P. Day, Ernest D. Klema, and Carlos A. Mallmann.*** *U. S. Atomic Energy Commission, ANL-6220,* Nov. 1960, 22 pp. (UF767 Un3.1an Contin.)

e * **Relationship Between Systems of Impenetrable Bosons and Fermions in One Dimension.** A rigorous one-one correspondence is established between one-dimensional systems of bosons and of spinless fermions. This correspondence holds irrespective of the nature of the interparticle interactions, subject only to the restriction that the interaction have an impenetrable core. The energy spectra of the two systems are identical, as are all configurational probability distributions, but the momentum distributions are quite different. ***M. Girardeau.*** *Journal of Mathematical Physics,* v. 1, no. 6, Nov.-Dec. 1960, p. 516-523.

f * **On Resolution and Luminosity of a Neutron Diffraction Spectrometer for Single Crystal Analysis.** Some criteria for the choice of the collimators for a crystal spectrometer for neutron diffraction are established in order to achieve a good compromise between luminosity and resolution. General expressions for the full width at half maximum and for the luminosity of the diffraction peaks are developed for single crystal samples. ***G. Caglioti, A. Paoletti, and F. P. Ricci.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 195-198.

g * **Pulse Shape Discrimination and Energy Response of Calcium Tungstate Crystals.** The scintillation response of calcium tungstate crystals to gamma rays, protons and alpha particles has been studied. It is shown that there is a difference in shape between gamma-ray and alpha-particle pulses, and that this effect may be exploited to discriminate between particles. ***W. R. Dixon and J. H. Aitken.*** *Nuclear Instruments and Methods,* v. 9, Nov. 1960, p. 229-232.

h * **Tests of Form of the One-Pion Exchange Potential.** The mathematical form of the one-pion exchange potential is tested by comparison with experimental material on nucleon-nucleon scattering. The tests are performed by modifying the form following from meson theory through changes in the proportions of spin-spin and tensor parts of the potential and also by adding a central potential part. These two tests are performed independently of each other. The absence of a definite effect for the proportion of spin-spin and tensor parts in tests performed fits expectation for the two-pion exchange potential. ***G. Breit, M. H. Hull, Jr., K. E. Lassila, and H. M. Ruppel.*** *National Academy of Sciences, Proceedings,* v. 46, Dec. 1960, p. 1649-1657.

i * **Decay of $Nd^{140} \rightarrow Pr^{140} \rightarrow Ce^{140}$.** An intermediate image magnetic spectrometer was used to study the continuous β^--spectrum of Pr^{140} and the Auger electrons of the decay chain $Nd^{140} \rightarrow$

j

k

$Pr^{140} \rightarrow Ce^{140}$. The maximum energy of the continuous β^+-spectrum is 2318 ± 10 keV. The ratio of the intensities of the different Auger groups $K - LL : LK - LX : K - MX = 1:(0.58 \pm 0.05) : (0.09 \pm 0.02)$. The ratio of the number of Auger electrons of the K-series to the electrons of the continuous spectrum e_K/β^+ is 0.292. ***V. Brabec, B. Kracik, and M. Vobecký.*** *Czechoslovak Journal of Physics*, v. 10, no. 11, 1960, p. 855-859.

* **The Decay of Ir^{194}.** The decay of Ir^{194} was investigated by means of a double focusing spectrometer, mostly by the photoelectron technique. A total of 32 transitions has been observed, and their energies and intensities have been measured. An internally converted transiton of 1480 keV, for which no gamma ray could be detected, showed that an O+ state of this energy is populated. The log *ft* values for the beta branches showed that all the 18 levels excited are of even parity. By comparison of the measured gamma intensities with the conversion intensities of corresponding transitions in the decay of Au^{194}, spin values could be assigned for many levels. Evidence for a new 0+ state at 1547 keV was obtained in this manner. Indications were found for EO admixture in competition with M1 and E2 multipolarities. A state at 923 keV may be interpreted as the 3+ level in the asymmetric rotor theory. ***J. Kern and G. Bäckström.*** *Nuclear Physics*, v. 19, no. 3, Nov. 1960, p. 461-481.

Trends in Sodium Equipment. Because most mechanical components for sodium reactors were adapted from designs for petroleum and water service, they fail to exploit sodium's superior heat-transfer ability and fall heir to thermal-stress problems. New designs alleviate these problems while fresh concepts forge the way toward 2,200-psi 1,050-1,200 F steam. ***Robert W. Dickinson and John B. Williams.*** *Nucleonics*, v. 19, Jan. 1961, p. 65-70.

* **Observation of the Hyperfine Structure Splitting of Muonium by Use of a Static Magnetic Field.** ***R. Prepost, V. W. Hughes, and K. Ziock.*** *Physical Review Letters*, v. 6, no. 1, Jan. 1, 1961, p. 19-21.

Perspectives for the Use of Nuclear Power in Aviation. A study of the "direct-cycle system" and the "intermediate heat-transfer agent system" which are nowadays the subject of experiments in the countries with a most advanced aeronautic and nuclear development. Mentions the most complex problems in the development of a nuclear aircraft: the high-temperature requirements, the huge heat-flows, and above all the shielding system against ionizing radiation. (*In Italian.*) Aspetti e problemi della applicazione della propulsione nucleare negli aeromobili. ***Fridolino Mayer.*** *Aerotechnica*, v. 40, no. 5, Oct. 1960, p. 287-298.

IBM 650 Routine VI Temperature Distribution in Fuel Elements. Equations and a routine for the IBM 650 to calculate temperatures within cylindrical fuel assemblies are presented. The routine can accommodate as many as three coaxial fuel tubes and four coolant channels. ***James C. Jensen.*** *U. S. Atomic Energy Commission, DP-512*, Sept. 1960, 48 pp. (UF767 Un3.1dp Contin.)

Nuclear Analysis of Thermal Reflected Cylindrical Homogeneous Critical Assemblies. Twenty-three small, cylindrical, UO_2F_2-aqueous-solution, water-reflected, critical assemblies were analyzed, utilizing few group diffusion theory with the one-dimensional code WANDA. The fast group constants were obtained using the MUFT code which computes the flux spectrum in a material of prescribed composition and buckling. The cross sections are then averaged over this spectrum to obtain the MUFT constants. Maxwellian thermal-spectrum constants for the slow group were obtained with the SOFOCATE code. Also, three large, $UO_2(NO_3)_2$-aqueous-solution, cylindrical, critical assemblies were analyzed for comparison. ***G. P. Rutledge and P. A. Kantorczyk.*** *U. S. Atomic Energy Commission, WAPD-TM-244*, Nov. 1960, 18 pp. (UF767 Un3.1wa Contin.)

Assembly of Fifty Prototype Fuel Assemblies for the Experimental Gas-Cooled Reactor. Sufficient components for 50 fuel assemblies of the Title I design were procured commercially in accordance with detailed specifications, and were assembled in a pliot-plant operation. Al components and completed assemblies were inspected carefully. The fabricability of the design was confirmed, and several important modifications

in the specifications and design were developed. Reliable cost estimates also were obtained on sufficient components for a reactor loading. In addition, process specifications were developed for the welding and brazing operations. ***E. A. Wick and R. L. Heestand.*** *U. S. Atomic Energy Commission, ORNL-2936*, Dec. 23, 1960, 88 pp. (UF767 U3o Contin.)

* **A Cryogenic Device for Irradiation in Liquid Nitrogen.** A brief review of existing types of liquid-N loops followed by a description of a loop operating according to a new principle, for irradiation in a permanent liquid-N bath. This extra-pure N contained in a small vessel is recondensed in ordinary liquid N at a certain distance from the core in a zone where the flux is weak, so as to eliminate any explosion hazards, and flows back into the bath under the action of gravity. The design of the apparatus is extremely simple and it is reliable in operation owing to the absence of mechanical circulating equipment. The consumption of N is quite small. The apparatus enables the samples to be taken out in a cold condition. It has operated satisfactorily for several continuous one-week periods. ***L. Bochirol, J. Doulat, and L. Weil.*** *Cryogenics*, v. 1, no. 1, Sept. 1960, p. 44-46.

Principles of Radiation Dosimetry. Deals exclusively with the measurement of X-rays, gamma rays, charged particles and neutrons. It relates both the idealized concepts and the measured quantities to the properties of the radiation field. New definitions specifying the exposure dose and absorbed dose, as set forth by the International Commission on Radiological Units in 1956, are discussed and clarified. Includes also a treatment of the interactions of radiations with matter designed to help the scientist and research worker understand the problems of detection and dosimetry. ***G. N. Whyte.*** 124 pp. 1959. John Wiley & Sons, New York. (QC475 W62r)

Progress in Nuclear Physics. The Composition of the Primary Cosmic Radiation by C. J. Waddington; The Interaction of Polarized Nucleons with Nuclei by E. J. Squires; Collective Motion in Nuclei by D. M. Brink; Dispersion Relations for Elementary Particles by J. Hamilton; Cherenkov Detectors by G. W. Hutchinson; The Photoproduction of Pions by E. H. Bellamy. ***O. R. Frisch, editor.*** v. VIII. 304 pp. 1960. Pergamon Press, New York. (QC776 P94 Vis.)

Annual Review of Nuclear Science. A collection of 19 papers by various authors on nuclear science. ***Emilio Segrè, editor.*** v. X. 617 pp. 1960. Annual Reviews, Inc., Palo Alto, Calif. (QC780 An78 Vis.)

Lifetime of the First Excited State of N^{14}. The mean life of the first excited state of N^{14} has been measured by nuclear resonant scattering. The $N^{14}(p,p')$ reaction with an N^{14} enriched gaseous ammonia target was used as the source of Doppler-broadened γ radiation. The value of $(7.3 \pm 1.8) \times 10^{-14}$ sec obtained is a factor of two longer than theoretical predictions based on the wave functions used to explain the anomalously slow C^{14} β decay. ***C. P. Swann, V. K. Rasmussen, and F. R. Metzger.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 242-245.

A Portable Integrating Scintillation Counter. The instrument described was designed for use where the levels of activity are two low for the ratemeter type of arrangement to give sufficient activity. A high-speed electromechanical counter preceded by a decade scaler is used. The complete equipment, including the photo-multiplier power supply, is transistorized and is fully portable. ***J. C. Harvey.*** *Electronic Engineering*, v. 33, Jan. 1961, p. 28-31.

* **Angular Correlation in $C^{12}(n, n' \gamma)C^{12}$ at 14 MeV.** A method is developed for measuring angular correlation in inelastic scattering of 14 MeV neutrons. Random coincidences are practically suppressed by combining time-of-flight and fast-coincidences techniques. Angular correlation has been measured on the first excited state of C^{12} and the results are in good agreement with Banarjee and Levinson's calculations based on the distorted-wave method. ***G. Deconninck and A. Martegani.*** *Nuclear Physics*, v. 21, no. 1, Nov. 1960, p. 33-37.

* **Optical Model Analysis of the Scattering of 96 MeV Neutrons by Nuclei.** Total, absorption and small-angle elastic differential cross-sections for Li, Be, C, Al, Cu, Cd, Pb, and U are fitted by the optical model. ***P. E. Hodgson.*** *Nuclear Physics*, v. 21, no. 1, Nov. 1960, p. 21-27.

*** The Elastic Scattering of 96 MeV Neutrons by Nuclei.** The differential cross sections for the elastic scattering of neutrons of mean energy 96 MeV, were measured out to the first diffraction minimum for Li, Be, C, Al, Cu, Cd, Pb, and U. ***G. L. Salmon.*** *Nuclear Physics*, v. 21, no. 1, Nov. 1960, p. 15-20.

*** The Angular Distributions of the Gamma Radiation From the $Li^7(p,\gamma)Be^8$ Reaction From $E_p = 200$ keV to 1100 keV.** The angular distributions of the resonant gamma rays are isotropic at $E_p = 441$ keV and are consistent with the resonance being p-wave ($J = 1+$) with channel spins 1 and 2 in the ratio 1/5; they do not lead to definite conclusions on the mechanism of the 1030 keV resonance but are not inconsistent with the resonance being p-wave ($J = 1+$) with channel spins 1 and 2 in the ratio 1/5, the resonance radiation being isotropic but mixed with a d and s-wave contribution in the nonresonant background. ***B. Mainsbridge.*** *Nuclear Physics*, v. 21, no. 1, Nov. 1960, p. 1-14.

*** Effective Spin-Orbit Potential in Correlated Heavy Nuclei.** We consider a many-body system in which a particle N moves under the influence of the remaining $N - 1$ particles, taken to be nucleons, and every total particle-particle interaction contains a repulsive core. An expression is derived for that part of the effective one-body potential felt by particle N which is due to a specific portion v_{iN} of its interaction with each of the nucleons $i = 1, \ldots, N - 1$, on the basis of a system wave function of the Jastrow type, neglecting exchange contributions involving particle N. This result is used to estimate the spin-orbit splittings in the region of Pb^{208} generated by the Gammel-Thaler and Signell-Zinn-Marshak two-body spin-orbit potentials. ***John W. Clark.*** *Annals of Physics*, v. 11, Dec. 1960, p. 483-500.

*** Matter at High Densities.** The equation of state of matter in its most stable form at different densities ρ and at zero temperature is discussed. The energy and pressure of a neutron gas is calculated at densities where the interparticle distance is large compared with the effective range. Energy and pressure of a neutron gas at densities comparable to nuclear densities are estimated next, using a semi-empirical method. ***E. E. Salpeter.*** *Annals of Physics*, v. 11, Dec. 1960, p. 393-413.

*** Neutrons From the Capture of a Polarized Mu Meson.** The angular distribution of the neutrons from the capture by a spinless nucleus of a totally polarized mu meson in the 1*s* Bohr orbit, is calculated via two single-particle nuclear models, termed "modified Fermi gas" and "square well". The "modified Fermi gas" calculations, performed for Ca^{40} and Pb^{208}, employ a Fermi sea of protons and $\mu^- + p \rightarrow \nu + n$ to produce neutrons at a localized zone of the nucleus, which are followed through the nuclear surface via geometrical optics. The "square-well" calculations, performed for O^{16}, Si^{28}, and Ca^{40}, employ eigenfunctions of a real square well of finite depth for the nucleons, and a spherical harmonic expansion up to *g*-waves, inclusive, of the neutrino plane wave. k Ranges from several to ~30 per cent. ***Elihu Lubkin.*** *Annals of Physics*, v. 11, Dec. 1960, p. 414-482.

*** Aspects of the Deposition of Radioactive and Other Gases and Particles.** Radioactive nuclides are present in air in very low mass concentrations, and are usually subject to rapid and irreversible adsorption at surfaces. Velocities of deposition of order 1 cm/sec are found for the dry deposition of iodine-131 vapor to surfaces in the laboratory and in the field. ***A. C. Chamberlain.*** *International Journal of Air Pollution*, v. 3, nos. 1-3, Oct. 1960, p. 63-88.

Geiger Counter Backgrounds. An extensive study of counting backgrounds in ten essentially identical Geiger counters is reported. Important long-term time variations were found; their rate is generally less than ½% per day, they change direction frequently and their total magnitude averages about 6%. They could not be correlated with counter efficiency, and were not, in general, correlated among the different counters. Consecutive day differences were generally less than 1% ,although about 20% of the time there were nonstatistical variations in the same direction in all counters, averaging 2.3% in magnitude. No day-night variations were detected within an accuracy of one part in 300. Temperature effects were found to be extremely important. An experience with an area-wide air contamination is discussed. ***B. L. Cohen.*** *Journal of Scientific Instruments*, v. 37, Dec. 1960, p. 475-478.

*** The Decay of Pm^{149}.** The 52.8-hour activity of Pm^{149} was investigated using a high resolution beta spectrometer, a lens type coincidence spectrometer, and a scintillation spectrometer in conjunction with a multichannel analyzer. The beta spectrum was found to consist of two groups with maximum energies of 1.072 ± 0.002 Mev and 0.786 ± 0.004 Mev, and intensities of 97.1 ± 0.4% and 2.9 ± 0.4%, respectively. A gamma ray of energy 285.7 ± 0.3 kev was found to be in coincidence with the 0.786-Mev beta group. No other gamma rays with intensities greater than 0.1% were found. The K conversion coefficient for the 286-kev transition was measured to be 0.075 ± 0.008. This, together with the values of 6.5 ± 0.7 and 4 ± 1 obtained for the K/L and L/M conversion ratios, respectively, indicate that this transition is $M1$ in character with less than 10% $E2$ admixture. ***Agda Artna and Margaret E. Law.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1577-1585.

*** On the Summation of Generalized Ladders for a Many-Fermion System.** The analogy between an interacting fermion system and a system in an external potential, which may be nonhermitian, is employed to show why the generalized ladder approximation for an interaction attractive near the Fermi-surface diverges. ***M. L. Mehta.*** *Nuclear Physics*, v. 20, no. 4, Nov. 1960, p. 533-542.

*** The Identification and Half Lives of Fission-Product Rb^{97} and Rb^{98}.** The existence of two new Rb isotopes, Rb^{97} and Rb^{98}, has been established and their half lives measured. The half lives of these short-lived fission products were determined using a technique of timed precipitations. The values obtained for Rb^{97} and Rb^{98} were 5.3 ± 0.5 sec and 5.6 ± 0.5 sec, respectively. The half lives of the Sr and Y daughters were also determined. The Sr isotopes were studied by observing the decay rate of a characteristic γ-ray peak. For Sr^{97}, the decay of the 1.37-Mev line gave a value of 2.71 ± 0.02 hr. A γ-ray peak at 590 kev, which was found to be associated with Sr^{98}, decayed with a half life of 7.54 ± 0.06 min. The half lives of the Y daughters were determined by β counting. The values found for Y^{97} and Y^{98} were 3.53 ± 0.02 hr. and 10.1 ± 0.1 hr., respectively. ***K. Fritze and T. J. Kennett.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1614-1622.

*** The "Reactor" Neutron Capture Cross Section of Y^{91}.** A high specific activity source of Y^{91}, freed from natural U and rare earths, was irradiated in a high flux position in the NRX reactor. After further chemical purification, 3.6-hour Y^{92} was identified in the sample by measurement of the 3.6-Mev β-particle associated with its decay, using a scintillation spectrometer. Two such measurements have established the reactor neutron capture cross section of Y^{91} to be 1.4 ± 0.3 barns. ***Gwen M. Milton and W. E. Grummitt.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1690-1701.

*** Investigations of a Self-Target for the D(d, n) He^3 Reaction.** An apparatus was described used at a 128 keV deuteron energy and with a 80μA deuteron current. Massive, galvanized and metallized specimens of 31 elements, 8 alloys and 1 compound were studied. The neutron-saturation yield A depends closely on the target material and its surface finish. Differences in the yield by a factor of 210 were measured. The yield curves were examined from the viewpoint of the diffusion theory. (*In German.*) Untersuchungen an Selbsttargets für die Reaktion D(d, n) He^3. ***Roland Weisbeck.*** *Zeitschrift für Angewandte Physik*, v. 12, no. 12, Dec. 1960, p. 529-538.

*** A New Isomeric State of Cs^{131}.** A new isomeric state at 133 keV was found. The half life was determined as $T_{1/2} = 133$ ± 0.5 ns. The level is interpreted as the $g_{7/2}$ shell model state. A new determination of the half life of the 124 keV level gave $T_{1/2} = 3.77$ ± 0.05 ns. ***E. Bodenstedt, H. J. Körner, C. Günter, D. Hovestadt, and J. Radeloff.*** *Nuclear Physics*, v. 20, no. 4, Nov. 1960, p. 557-560.

*** Exceptions to Gamma Intensity Rules in Nuclear Rotational Spectra.** The usual gamma intensity rules in nuclear rotational spectra can be proved only for transition operators that do not depend on collective angular momentum. It is shown that in the Bohr-Mottelson nuclear model only the magnetic dipole and magnetic octupole operators do not satisfy this condition and thus may give rise to unusual branching ratios. ***K. Helmers.*** *Nuclear Physics*, v. 20, no. 4, Nov. 1960, p. 585-588

• **The Electron Spectrum of $_{81}Tl^{199}$.** The electron spectrum between 5.75 and 950 keV of mass separated Tl^{199} sources was studied in a double-focusing β-spectrometer, adjusted to a momentum resolution of about 0.4%. The experimental findings are in accordance with the following level sequence in Hg^{199}: ground state (1/2−), 158.4 (5/2−), 208.2 (3/2−), 403.4 (1/2−), 455.4 (1/2−), and 492.2 keV (3/2−). The half-life of Tl^{199} was measured as 7.42 ± 0.08 h. The K- and L-Auger spectra of Hg are briefly discussed. ***B. Jung and J. Svedberg.*** *Nuclear Physics,* v. 20, no. 4, Nov. 1960, p. 630-647.

• **Excitation of Heavy Nuclei by Fast Nucleons.** Nuclear reactions induced by fast nucleons are studied on the basis of a classical model. A formula is obtained to calculate the energy spectrum of all nucleons emitted, taking account of the successive collisions between the incident nucleon and the nucleons in the target nucleus. The result is compared with the energy spectrum predicted by the statistical theory. Calculated energy spectra and cross sections are found to be in fair agreement with the experimental results. ***Ken Kikuchi.*** *Nuclear Physics,* v. 20, no. 4, Nov. 1960, p. 601-613.

• **Classical Treatment of Nuclear Reactions Induced by Fast Nucleons.** The direct process in nuclear reactions is studied using a simplified classical model. The process of the usual inelastic scattering type is found to give a contribution of 10 to 25% to the total cross section. The more complicated processes, in which two or more collisions take place, seem to contribute 10% to the absorption cross section. ***Ken Kikuchi.*** *Nuclear Physics,* v. 20, no. 4, Nov. 1960, p. 590-600.

• **Optical Model Analysis of Negative Pion-Proton Elastic Scattering Between 1.4 and 6.8 GeV.** Elastic scattering of negative pions on protons is analysed in terms of an optical model. The rms radius of the adsorptive region is found to be

$\langle v^2 \rangle^{\frac{1}{2}} = (0.521 \pm 0.016) \cdot 10^{-13}$ cm. ***G. Domokos and A. Sebestyen.*** *Nuclear Physics,* v. 21, no. 1, Nov. 1960, p. 157-160.

• **New Nucleide Actinium-231.** A new nucleide actinium-231 was identified from the reaction of $Th^{232}(\gamma, p)Ac^{231}$ induced by the 25-MeV bremsstrahlung. The activity was chemically separated from fission products with the aid of a recoil method. The half-life of this new isotope was found to be $T_{\frac{1}{2}} = 15 \pm 1$ min. ***K. Takahashi and H. Morinaga.*** *Nuclear Physics,* v. 21, no. 1, Nov. 1960, p. 133-136.

• **Spin-Orbit Coupling for Spin-1 Particles.** A one-body spin-orbit potential for spin-1 particles may contain, in addition to the familiar vector term $\mathbf{l} \cdot \mathbf{s}$ used with spin-½ particles, certain tensor terms T. The T may be constructed from the position, momentum and angular momentum vectors of the particle. Time reversal invariance cannot be demanded if a complex potential is allowed, but the requirements of parity conservation and symmetry of the scattering matrix allow only three forms of T. Only one of these remains diagonal in the orbital angular momentum. ***G. R. Satchler.*** *Nuclear Physics,* v. 21, no. 1, Nov. 1960, p. 116-127.

• **Aluminium (p,γ) Resonances With H_1+, H_2+ and H_3+ Ions.** Thick target gamma-ray yield curves from H_2+ ions are very asymmetric. They are accurately fitted by assuming the electron in the ion is torn away the moment the target is struck. The ensuing Coulomb force pushes the two protons apart. Proton energies in the laboratory system are substantially changed, and some protons pass through the resonance twice. ***P. F. Dahl, D. G. Costello, and W. L. Walters.*** *Nuclear Physics,* v. 21, no. 1, Nov. 1960, p. 106-115.

• **Classification of Alpha Particle Wave Functions.** A classification is given of the functions which can occur in the alpha particle ground state wave function. Isobaric spin functions, spin and orbital angular momentum functions, and internal functions are classified according to their behavior under the permutation group of four particles, and combined to form completely antisymmetric functions. Three S-state functions, eight P-state functions, and six D-state functions are obtained. ***L. Cohen.*** *Nuclear Physics,* v. 20, no. 4, Nov. 1960, p. 690-697.

Alpha-Particle Decay of the 15.1 MeV State in ^{12}C. A search was carried out for the α-particle decay of the 15.1 MeV state in ^{12}C. The state was made by the ^{10}B (^3He, p) ^{12}C reaction. The protons feeding the 15.1 MeV state were seen in proton singles spectra and in coincidence with 15.1 MeV γ-rays, but none were seen in coincidence with α-particles. Comparison with a nearby state known to decay virtually solely by α-particles established that the 15.1 MeV state α-decays less than 20% of the time. Combining this result with the results of γ-ray resonance scattering we find that $\Gamma_\alpha < 15$ eV. The sensitivity of the experiment was limited by a continuum from the break-up of the $^{10}B + {}^3He$ system. ***G. L. Miller and R. E. Pixley.*** *Royal Society, Proceedings,* v. 259, ser. A, Dec. 6, 1960, p. 275-284.

Yield Measurements of Alpha Particles From the $^{27}Al(p, \alpha)^{24}Mg$ and $^{31}P(p,\alpha)^{28}Si$ Reactions. Of the twelve known $^{27}Al(p,\gamma)^{28}Si$ resonances in the $E_p = 500$-850 keV region only those at $E_p = 504$, 631, and 728 keV gave a detectable alpha-particle yield. Of the five $^{31}P(p,\gamma)^{32}S$ resonance levels in $E_p = 400$-850 keV region only that at $E_p = 641$ keV shows detectable alpha-particle emisison. ***J. Kuperus and P. B. Smith.*** *Physica,* v. 26, Nov. 1960, p. 954-960.

• **Dounreay Fast Reactor. I. Design of Core. II. Reactor Vessel, Fuel Handling and Shielding. III. Heat Transfer Circuits. IV. Heat Transfer Circuits and Reactor Control.** *Engineer,* v. 210, I. Dec. 9, 1960, p. 978-981; II. Dec. 16, 1960, p. 1011-1016; III. Dec. 23, 1960, p. 1046-1050; IV. Dec. 30, 1960, p. 1105-1107.

• **Meteorological Fractionation of Nuclear Bomb Debris.** Deposits at a mountain station in Norway appear to have contained more short-lived fission products than those at lowland stations, especially during periods when considerable fresh fission products have been present in the atmosphere. ***Per B. Storebö.*** *Tellus,* v. 12, no. 3, Aug. 1960, p. 293-297.

• **Decay of Ho^{156}.** The conversion spectrum of the radioactive isotope holmium of a half-life of 56 minutes was investigated by the conversion spectrometer with a double focusing on the angle $\pi\sqrt{2}$. The isotope Ho was obtained on exposure of Ta to protons with an energy of 660 Mev in a synchrocyclotron. (*In Russian.*) Raspad Ho^{156}. ***E. P. Grigor'ev and B. S. Dzhelepov.*** *Akademiia Nauk SSSR, Doklady,* v. 135, no. 3, Nov. 1960, p. 564-567.

Optical Model Analysis of Nuclear Scattering. The mathematical methods used in a calculation of nuclear interactions by the optical model are described, and the most efficient way of programming the calculation for an electronic computer investigated. ***B. Buck, R. N. Maddison and P. E. Hodgson.*** *Philosophical Magazine,* v. 5, ser. 8, Nov. 1960, p. 1181-1191.

The Effect of Radiation on Selected Properties of Spherical Graphite Fuel Elements. As part of the fuel-element-evaluation program for the Pebble-Bed Reactor, 1.5-in. diameter graphite spheres fueled with UO_2, UC_2, and UC particles were irradiated at 1300 to 1700 F to uranium-235 burnups of 1.6 to 8.6 a/o. The study included bare graphite spheres and spheres coated with siliconized silicon carbide and pyrolytic carbon. Of the six coated spheres, only two, coated with silicon carbide, did not have cracks in the coating after irradiation. The uncoated graphite spheres contracted. Diameters decreased 0.2 to 0.9%. These decreases are not easily correlated with burnup. Highly graphitized spheres showed more contraction than spheres containing less-ordered carbon structures. ***Allison K. Smalley, Richard J. Burian, Arnold F. Gerds, Gilbert E. Raines, and Ward S. Diethorn.*** *U. S. Atomic Energy Commisison, BMI-1483,* Dec. 2, 1960, 21 pp. (UF767 U3b Contin.)

OPERATIONS RESEARCH

• **Optimal Policy for Dynamic Inventory Process With Stochastic Demands Subject to Seasonal Variations.** Most studies of dynamic stochastic inventory problems in which explicit evaluations of the optimal policies are obtained, are restricted by the assumption that the probability distribution of demand is not time dependent. This paper considers the case where the demand distribution may vary over successive periods, but in a cyclical fashion. ***Samuel Karlin.*** *Society for Industrial and Applied Mathematics, Journal,* v. 8, no. 4, Dec. 1960, p. 611-629.

ORE AND MATERIALS BENEFICIATION

*** Change of the Flocculating Action of Flotation Agents in Time.** The collectors exhibit the maximum flocculating action on galenite and pyrite in the first moment of contact of the mineral with the solution of the flotation agent. During the first two hours the flocculating action of the collector decreases slowly. Introducing terpineol increases the flocculating action of ethyl xanthogenate, but later there is peptization of the floccules formed. (*In Russian.*) Izmenenie flokuliruiushchevo deĭstviia flotoreagentov vo vremeni. ***T. P. Avilova and A. S. Sergeeva.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Gornyi Zhurnal,* 1960, no. 11, p. 193-199.

*** Slime-Coatings in Galena Flotation.** Objective is to show how the electrical double layer on slime particles determines whether a given type of slime can affect the flotation of galena and how this detrimental effect can be overcome by finding conditions which change the surface properties of the slime. ***A. M. Gaudin, D. W. Fuerstenau, and H. L. Miaw.*** *Canadian Mining and Metallurgical Bulletin,* v. 53, no. 584, Dec. 1960, p. 960-963; *Canadian Institute of Mining and Metallurgy, Transactions,* v. 63, 1960, p. 668-671.

*** Ultrasonic Aided Extraction of Uranium From Rock.** The extraction of U from rock under the action of ultrasonic waves of various frequencies was investigated. Shows that during irradiation a sodium solution extracts U from rock twice as completely and seven times as fast as during simple mixing. Increase in frequency of the ultrasonic vibrations leads to acceleration of the process and to more complete extraction. (*In Russian.*) Ektraktsiia urana iz gornoĭ porody pod vliianiem ultrazvuka. ***P. F. Andreev, E. M. Rogozina, and Yu. M. Rogozin.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 11, Nov. 1960, p. 2429-2430.

*** Krupp-Renn Direct Reduction Process.** Iron ores that have a wide range of physical characteristics and chemical analyses can be reduced without metallurgical coke by using anthracite fines, coke breeze or carbonized char from high volatile fuels. ***Max J. Kennard.*** *Mining Congress Journal,* v. 47, Jan. 1961, p. 34-37.

PHYSICS

Magnetic Field Dependence of Energy Gap in Superconductors. The dependence of energy gap in superconductors on static magnetic fields has been derived in a gage-invariant way from the theory of Bardeen, Cooper, and Schrieffer. It has been shown that the gap width decreases with magnetic field approaching the critical value. Optimum conditions have been discussed for the observation of such an effect. The decrease in gap width has been calculated for two superconductors, Al and Sn, and it has been shown that for film thickness between 10^{-4} to 10^{-5} cm, the effect can be large enough to be observable. ***K. K. Gupta and V. S. Mathur.*** *Physical Review,* v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 107-117.

*** Growth of Dislocationless Single Crystals of Silicon.** By means of etching and decorating processes with Cu the sources of dislocations at each stage of growth of Si crystals grown by the Chokhral'skii method were studied. Defective growth and superficial dislocation in the seeding are the main source of dislocations at the beginning of growth. In the lower part of most crystals grown, a precipitation of some impurities, possible Si carbide, in the form of dendrites, was observed. Dislocationless Ge crystals were grown by the same method. (*In Russian.*) Rost bezdislokatsionnykh monokristallov kremniia. ***U. Desh.*** *Uspekhi Fizicheskikh Nauk,* v. 72, no. 3, Nov. 1960, p. 495-520.

*** Calculation of Wavelengths From Reflecting Echelon Patterns.** By measuring to the position of the center of the envelope, rather than to an arbitrary mirror image, it is shown that envelope correction is automatically applied and a very simple correction for nonlinearity of dispersion may be made where necessary. ***R. A. Hands, W. A. Heslop, and T. A. Littlefield.*** *Optica Acta,* v. 7, no. 4, Oct. 1960, p. 325-330.

*** Dielectric Specific Inductive Capacitances of Ceramic Piezoelements From $BaTiO_3$.** In nonpolarized $BaTiO_3$ ceramic the separate domains making up its microcrystals cannot be considered as fully piezoelectrically pressed (at frequencies up to 10^8 cy sec). The decrease of the capacitance studied with increase of the frequency is the result of dielectric relaxation. (*In Russian.*) Dielektricheskie pronitsaemosti keramicheskikh p'ezoelementov iz $BaTiO_3$. ***S. V. Bogdanov.*** *Akademiia Nauk SSSR, Izvestiia, Seriia Fizicheskaia,* v. 24, no. 11, Nov. 1960, p. 1353-1356.

Instability of the Induction (Theta) Pinch. Photographs of the plasma theta-pinch, obtained by the "time magnifying" method at the exposure speed of 2×10^6 frames per second are studied. These photographs point to an extremely complicated character of plasma motion, and to the existence of varied forms of instability of the pinch. The interrelationship between the character of the plasma motion and the form of instability were considered. Certain facts bring out the important role of "runaway" electrons in the formation of instability. ***I. F. Kvartskava, K. N. Kervalidze, and Yu. S. Gvaladze.*** *U. S. Atomic Energy Commission, AEC-tr-4072,* Oct. 1960, 19 pp. (UF767 Un3.1ae Contin.)

*** Superfluidity and Specific Heat of Liquid Helium in "Vycor" Porous Glass.** The flow rate of liquid helium through disks of "Vycor" porous glass was measured as a function of temperature at constant pressure head. The specific heat of liquid helium within the same disks was also measured. The mean pore diameter as given by adsorption measurements is 71 Å, and the onset of superfluidity and the specific heat maximum occurred, respectively, at 2.0 ± 0.1 K and at 2.06 K. The effect of pore size distribution is discussed, and the results compared with similar measurements using the unsaturated helium-II film. ***D. F. Brewer, D. C. Champeney, and K. Mendelssohn.*** *Cryogenics,* v. 1, no. 2, Dec. 1960, p. 108-113.

*** Cooling by Adiabatic Magnetization of Superconductors.** In order to develop a method of attaining temperatures below 1 K, a cryostat has been designed to investigate the fall in temperature on magnetizing superconductors. It is found that by magnetizing a cylindrical specimen of pure Sn from an initial temperature of 0.9 K, the lowest tempearture which can be reached is 0.35 K. This is substantially higher than the expected value of 0.02 K for ideal cooling. Magnetizations have also been performed on tin-indium alloys. The lowest temperatures obtained with 0.5, 1.0, and 2.0% alloys are 0.19, 0.18, and 0.345 K respectively. It has been shown that the time taken to warm from 0.35 K, the lowest temperature attained with pure Sn, can be as long as six hours. The causes of irreversibility, supported by indirect evidence, are discussed. ***M. Yaqub.*** *Cryogenics,* v. 1, no. 2, Dec. 1960, p. 101-107.

Stability of a Diffuse Hollow-Core Toroidal Pinch. Discusses the reduction of the energy integral for a general toroidal pinch. After some manipulation, a form for the δW integral is found which, it is hoped, may prove useful in further investigations. One simple result that is found is an extension to the toroidal hollow-core pinch of the well known cylinder result that it is sufficient for stability, in the latter case, that $J_z B_\theta$ ≤ 0 everywhere. ***B. R. Suydam.*** *U. S. Atomic Energy Commission, LAMS-2477,* Oct. 15, 1960, 17 pp. (UF767 Un3.1L Contin.)

*** "Front" Description in Relativistic Quantum Mechanics.** The problem of introducing a Cartesian position operator canonically conjugate to the momentum operator into relativistic one-particle theories is investigated independent of any particular relativistic wave equation. The known result that such a description is possible for particles with nonvanishing mass is rederived. ***R. Acharya and E. C. G. Sudarshan.*** *Journal of Mathematical Physics,* v. 1, no. 6, Nov.-Dec. 1960, p. 532-536.

*** On the Nonexistence of a Class of Static Einstein Spaces Asymptotic at Infinity to a Space of Constant Curvature.** It is known that there exist no nontrivial static regular solutions of the Einstein vacuum equations $R_{ik} = 0$ which are asymptotically Galilean at infinity. One may ask correspondingly whether there exist static solutions of the equations $R_{ik} = \lambda g_{ik} (\lambda <$ which are regular at all finite points and asymptotic (in a sense to be defined) to a space of constant curvature at infinity. T

answer to this question is here shown to be in the negative. ***H. A. Buchdahl.*** *Journal of Mathematical Physics*, v. 1, no. 6, Nov.-Dec. 1960, p. 537-541.

* **Density of Liquid Oxygen as a Function of Pressure and Temperature.** A description is given of an apparatus for measuring the density of liquefied gases as a function of pressure. Experimental results of the density of liquid oxygen as a function of temperature and pressure are given from 90 K to 65 K and up to 150 kg/cm^2. Some thermodynamic properties, such as γ, the Poisson's ratio, and W, the velocity of sound, are calculated. A comparison with the existing measurements of these thermodynamic functions is made. ***A. Van Itterbeek and O. Verbeke.*** *Cryogenics*, v. 1, no. 2, Dec. 1960, p. 77-80.

Surface Electroconvection. An electric field can produce steady cellular motions in the interface region of two immiscible semiconducting fluids. The theory of this instability is explored. The characteristic parameter is found to depend upon the difference in conductivity of the fluids and the curvature of the interface. Quantitative finite amplitude experiments established that the electric current produced by the cellular motions is proportional to the characteristic parameter minus the critical value of this parameter. ***W. V. R. Malkus and G. Veronis.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 13-23.

Longitudinal Ion Oscillations in a Hot Plasma. Linearized, longitudinal waves in a hot plasma include, besides the familiar electron plasma oscillations, in which the frequency ω is of order $\omega_p = (4\pi ne^2/m)^{\frac{1}{2}}$, also ion plasma oscillations with $\omega \sim \omega_p(m/M)^{\frac{1}{2}}$. The properties of the latter are explored using a Vlasov equation description of the plasma. For equal ion and electron temperatures, $T_e = T_i$, there exists a discrete sequence of ion oscillations, but all are strongly damped, i.e., have $-\mathrm{Im}\ \omega/\mathrm{Re}\ \omega \gtrsim 0.5$, and hence are not likely to be observable. ***Burton D. Fried and Roy W. Gould.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 139-147.

* **Kemmer Wave Equation in Riemann Space.** The Kemmer equation is written in Riemann space. The form of the equation, the supplementary relations, and the form of the covariant derivatives of the operators β^μ are considered. As a check of the equation, it is shown that the equations for the values zero and one of the spin can be obtained from this generalized Kemmer equation with the help of generalized Fujiwara operators. ***Adel Da Silveira.*** *Journal of Mathematical Physics*, v. 1, no. 6, Nov.-Dec. 1960, p. 489-491.

Electronic Structure of the Centers in ZnS. A model of the common sulfide luminescent centers is proposed. The mutual perturbation of crystal eigenstates and transition-metal (activator) d eigenstates is assumed to give rise to the excited and unexcited eigenstates of the center. For substitutional $Cu^+(d^{10})$ in zincblende, zeroth order crystal field theory predicts that two sets of occupied center ground-state levels (T_2 and E) originating from d^{10} will exist. Additional level splittings result from (a) the spin-orbit effect, and (b) axial crystal field splittings in wurtzite. Experiments on visible and infrared, excitation and emissions, are used to make tentative assignments of magnitude of level splittings. ***Joseph L. Birman.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 144-145.

* **Contribution to the Theory of Ferro- and Antiferromagnetism.** A simple approximate method is developed which permits one to determine the magnetization of the lattice or sublattice and also other quantities of ferro- and antiferromagnets practically throughout the complete temperature range as a function of the dimensions and form of the magnetic system. The antiferromagnetism and ferromagnetism of small particles and polymers chains which under certain conditions can be regarded as forming a "paramagnetic fluid" are also considered. (*In Russian.*) K teorii ferro- i antiferromagnetizma. ***V. L. Ginzburg and V. M. Fain.*** *Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki*, v. 39, no. 5(11), Nov. 1960, p. 1323-1338.

The Problem of the Dual Nature of Light. Experiments with single photons provoke new thinking on the nature of light. The paradox that light behaves as either a train of waves or a beam of particles is partially resolved by consideration of fluctuations of light intensity. ***L. Jánossy.*** *New Scientist*, v. 8, Dec. 8, 1960, p. 1538-1540.

a **On the Design of Optical Systems With an Aspheric Surface.** Deals with the problem of designing a correcting aspherical surface which is situated in an arbitrary position within an optical system. The method requires the solution of two first-order differential equations and seems more suitable for the use with an electronic computer than methods previously proposed by other authors. It can be considered as a b differential form of a method previously proposed by E. Wolf. ***Kenro Miyamoto.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 21-22.

Theory of the Ellipsoidal Concave Grating. II. Application of the Theory to the Specific Grating Mountings. A recent treatment of ellipsoidal concave grating is applied to the c Seya-Namioka monochromator and the grazing incidence spectrograph. Numerical data which are considered to be useful in designing the instruments are presented in the form of graphs and tables. ***Takeshi Namioka.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 13-16.

Fiber Optics. VII. Image Transfer From Lambertian Emitters. VIII. The Focon. Light leakage between fibers for d the particular case of their use with Lambertian emitters is discussed. The associated problems of the degree of optical contact between the fiber ends and the emitting source, and their effects on the over-all transmitting efficiency are considered in detail and results are presented for several representative emitters. A transmission theory of fibers based on meridional ray considerations alone is derived and shown to be adequate for high numerical aperture fibers. Fiber optical elements, in the e form of a "field flattener," a "distortion corrector," and a "conical condenser" are combined in a single unit termed the "focon." It is capable of correcting for field curvature and distortion of a lens system and because of the increase in photographic speed using conical fibers, the problem of other aberrations is minimized. Various features of a focon are discussed and it is shown that high performance optical systems f are possible using simpler lens systems in conjunction with a focon. VII. ***N. S. Kapany and D. F. Capellaro.*** VIII. ***N. S. Kapany.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 23-24.

Electro-Optical Effect of Zincblende. The electro-optical coefficient of zincblende is measured by using the Senarmont compensator method for various wavelengths between 404 and g 644 mμ and the application of the crystal to light modulator of wide optical aperture is discussed. The electro-optical coefficient is found to be 5.9×10^{-8}cm/statvolt at room temperature for wavelength of 546 mμ. The voltage for obtaining half-wave retardation is about 10 kv. ***Susumu Namba.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 76-79.

h **The Mössbauer Effect: A Tool for Science.** When a whole crystal, rather than an atom, absorbs gamma recoil, tiny line widths permit measurements of gravitational red shift, nuclear-level splitting and many solid-state effects. ***Gunther K. Wertheim.*** *Nucleonics*, v. 19, Jan. 1961, p. 52-57.

* **Atomic Bricklaying Builds Semiconductors.** International Business Machines Corporation has recently demonstrated a i new technique for "growing" electronic components by arranging atoms of one material on top of another. Called "vapor growth", the new technique is a major advance in solid-state technology and has been used already by IBM to produce a variety of experimental semiconductor devices, including Esaki tunnel diodes and transistors. *Process Control and Automation*, v. 7, Dec. 1960, p. 645.

j **Measurement of the g Factor of Free, High-Energy Electrons.** 100-Kev electrons in 0.1-μsec bunches are sent into a gold foil. The part of the electron bunch which is scattered at right angles, and which, consequently, is partially polarized, is trapped in a magnetic field and held for a measured length of time (up to 300 μsec). The bunch is then released from the trap and allowed to strike a second gold foil. Counters reecive k the electrons scattered at plus and minus approximately 90°. The cycle is repeated 1000 times per sec. The asymmetry in intensity in the two directions depends upon the final direction of polarization. A plot of the intensity asymmetry vs. trapping

duration is a cosine curve, whose frequency is the difference between the orbital frequency and the spin precession frequency. This is related to the g factor as follows: $\omega_p m_0 c/Be = a$, where g is $2(1 + a)$. ***A. A. Schupp, R. W. Pidd, and H. R. Crane.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 1-17.

Volume-Controlled, Two-Carrier Currents in Solids: The Injected Plasma Case. Double injection into semiconductors and insulators is studied under conditions where the injected electrons and holes are free (injected plasma), the current is volume-controlled, i.e., determined by distributed space charge, and the current is field-driven (diffusion negligible). The major results are, assuming a one-dimensional geometry and carrier lifetime independent of injection level, for extrinsic semiconductors, (1) an extended voltage region over which $J \propto V^2$ (J current density and V voltage), and (2) depression of the current, at fixed voltage, in the square-law region through increase in the number of thermal minority carriers, $J \propto (n_T - _T)$, with n_T, p_T the thermal-equilibrium densities of electrons and holes, respectively. ***Murray A. Lampert and A. Rose.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 26-37.

Effect of High Pressure on Electrical Properties of NiO, CoO, CuO, and Cu_2O. The effect of pressure on electrical resistance and Seebeck coefficient at or near room temperature was determined. Equations relating the Seebeck coefficient to hole concentration were used to calculate the effect of pressure on hole mobility. In all materials examined, hole mobility was decreased by pressures to 60,000 atm. It is proposed that in NiO, CoO, and CuO, the decreased hole mobility with pressure was due to a decrease in diffusion rate of self-trapped holes. The explanation for pressure effects in Cu_2O may be more complicated since Cu_2O is generally regarded as a wide-band semiconductor. ***A. P. Young, W. B. Wilson, and C. M. Schwartz.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 77-82.

* **A Cryostat for Studying Transuranic Substances.** A cryostat used in conjunction with a glove-box is described. Such an apparatus is suitable for measuring the electrical resistivity and Hall effect of strongly alpha-active metals and alloys over the temperature range 1.4-300 K. ***G. T. Meaden and J. A. Lee.*** *Cryogenics*, v. 1, no. 1, Sept. 1960, p. 33-36.

* **The Effect of Radiation Damage on the Thermal Conductivity of Superconductors.** The effect of neutron irradiation at 30 C on the thermal conductivity of niobium and vanadium single crystals has been investigated at low temperature. Measurements were carried out in both superconducting and normal states where conduction is due predominantly to phonons and electrons, respectively. The observed effect on the phonon conductivity indicates an increase in the dislocation density whereas changes in electron conduction revealed the presence of vacancies. ***K. D. Chaudhuri, K. Mendelssohn, and M. W. Thompson.*** *Cryogenics*, v. 1, no. 1, Sept. 1960, p. 47-48.

Density Fluctuations and Heat Conduction in a Pure Liquid. Two components of the heat flux in a pure liquid are identified—one carried by sound waves and the other by diffusing molecules. Coupled relaxation equations are obtained for these components, both depending on the density gradient Δp, and this dependence is interpreted thermodynamically as a further coupling of these equations with the equation determining $(\partial/\partial t)(\Delta p)$. The latter can be immediately written down with the aid of Onsager's theorem and an inertial principle developed in a previous paper. The thermodynamic interpretation of these rate equations also leads to an explicit expression for the coefficient of $(\Delta p)^2$ in a Taylor expansion, about equilibrium, of the Helm-holtz free energy. This result is compared with similar free-energy terms assumed to exist by other authors. ***R. E. Nettleton.*** *Physics of Fluids*, v. 4, no. 1, Jan. 1961, p. 74-84.

Contributions to the Optics of Mirror Systems and Gratings With Oblique Incidence. I. Ray Tracing Formulas for the Meridional Plane. General ray tracing formulas have been developed for the "meridional plane" of noncentered optical systems consisting of imaging mirrors and gratings. It has been assumed that all centers of curvature of object and image field and of the aperture diaphragm lie in the meridional plane and that the grooves of a grating are perpendicular to that plane. The ray-tracing formulas have been simplified for a general ray with only small deviations from the instrument axis (zero ray). The influence of a change of diffraction for curved gratings has been included. ***Gottfried R. Rosendahl.*** *Optical Society of America, Journal*, v. 51, Jan. 1961, p. 1-3.

Energy-Momentum Tensor for Plane Waves. A general form is established for the energy momentum tensor for plane waves propagating in a homogeneous medium, the field equations of which are derivable from a quadratic Lagrangian function. Energy density and momentum density are proportional to frequency and the wave vector, the coefficient of proportionality being "action density". Energy flow and momentum flow are related to energy density and momentum density by the group velocity. The relation between momentum density and the wave vector is valid even in a nonlinear system. For a wave packet, one finds that the total energy is related to frequency and the total momentum to the wave vector by the total action of the packet, in close analogy with corresponding relations of quantum mechanics. ***P. A. Sturrock.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 18-19.

Debye Temperature of Orthorhombic Crystals at 0°K. Explicit formulas are obtained for the Debye characteristic temperature of orthorhombic crystals by an extension of Houston's method of expanding the integrand involved in terms of appropriate harmonic polynomials. Θ(elastic) values have been computed for 12 crystals and the results are discussed. ***S. K. Joshi.*** *Physical Review*, v. 121, ser. 2, no. 1, Jan. 1, 1961, p. 40-41.

Cyclotron Resonance in Lead. Cyclotron resonance effects of the Azbel'-Kaner type were observed in Pb specimens at 9 kMc/sec and 1.2 K, and effective mass values of the charge carriers were deduced from the magnetic field dependence of the surface resistance of the specimens. The anisotropy of the surface conductivity of the single crystal specimens in the low field limit was found to be consistent with the existing model of the Fermi surface in Pb, and from the value of the surface conductivity of a polycrystalline specimen, a value of the total Fermi surface area was found which supports the view that the fourth Brillouin zone in Pb is empty. ***J. E. Aubrey.*** *Philosophical Magazine*, v. 5, ser. 8, Oct. 1960, p. 1001-1012.

The Anisotropy of Optical Absorption Induced in Sapphire by Neutron and Electron Irradiation. In the spectrum induced by neutron irradiation, bands are resolved at −185 C at 1.9, 2.2, 2.8, 3.5, 4.1, 4.8, and 6.1 ev, the latter being measured both with a quartz spectrophotometer and a fluorite vacuum spectrograph. The 6.1 ev band was found to be isotropic, but the 2.8, 3.5, 4.1, and 4.8 ev bands were anisotropic, having parallel to perpendicular ratios greater than 1. The anisotropy measurements reveal the presence of a band of opposite anisotropy at 5.3 ev. In order to account for the complete shape of the spectrum of the anisotropic ratio, it is necessary to assume the presence of other bands having the same anisotropy as the 5.3 ev band. The 5.3 ev band did not appear in the electron irradiated specimens, although both the 4.8 ($\mu \| < \mu \perp$) and 6.1 ev (isotropic) bands were found. Possible models for these two centers are discussed. ***E. W. J. Mitchell, J. D. Rigden, and P. D. Townsend.*** *Philosophical Magazine*, v. 5, ser. 8, Oct. 1960, p. 1013-1027.

* **Electron-Hydrogen Atom Scattering in Born Approximation.** The elastic ($1s$-$1s$) and the inelastic ($1s$-$2s$, $1s$-$2p$) scattering cross sections in the Born approximation at energies of 1, 4, 9, 16 rydbergs have been calculated exactly from the closed formulas of the matrix elements for these transitions. Both the differential and the total cross sections are given. ***Ta-You Wu.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1654-1660.

* **A Solution of the Einstein Field Equations.** An exact, cylindrically symmetric, time-dependent solution of the Einstein gravitational field equations for empty space is derived. A particular case of the solution has singularities only on the axis of symmetry and may represent a number of particles in an otherwise empty universe. ***Peter Rastall.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1661-1664.

* **The Canadian Standard Free-Air Chamber for Medium Quality X-Rays.** A description is given of the Canadian standard free-air chamber for measurement of medium quality X-rays, including measurements of the contribution from radiation

scattered from the air and from the diaphragm, and a method for the accurate alignment of the chamber and X-ray source. ***W. H. Henry and C. Garrett.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1677-1689.

* **Scalar Diffraction by a Prolate Spheroid at Low Frequencies.** For the scalar problem of the diffraction of a plane wave by a prolate spheroid the exact solution is known, and by expanding this in ascending powers of ka, where k is the wave number and $2a$ is the interfocal distance, the Rayleigh series for both the "soft" and "hard" bodies are obtained up to and including terms in $(ka)^6$. The corresponding results for an oblate spheroid can be deduced by a trivial change of parameters. Some particular cases are examined. ***T. B. A. Senior.*** *Canadian Journal of Physics*, v. 38, Dec. 1960, p. 1632-1641.

* **Superhighfrequency Methods for Plasma Investigation.** This study covers the plasma conductivity in the field of superhighfrequency, resonator method, waveguide method, use of electron gas heating by means of a superhighfrequency field, sounding of plasma by means of waveguides, possibilty of using the space dispersion in the field of superhighfrequency for the investigation of high-temperature plasma. (*In Russian.*) Sverkhvysokochastotnye metody issledovaniia plazmy. ***V. E. Golant.*** *Zhurnal Tekhnicheskoĭ Fiziki*, v. 30, no. 11, Nov. 1960, p. 1265-1320.

* **The Effect of Bond Length Variations in Molecular Orbital Calculations of π-Electron Spectra-Aniline.** The effect of bond length changes on ground and excited state energies is examined. The results are applied to aniline. ***T. E. Peacock.*** *Molecular Physics*, v. 3, no. 5, Sept. 1960, p. 453-456.

* **The Calculation of Dispersion Forces.** By means of second-order perturbation theory and the use of the closure approximation, a simple closed formula is developed for the dispersion energy of interaction between spherical systems or molecules with axial symmetry. This expression contains an explicit two-electron correlation term. ***L. Salem.*** *Molecular Physics*, v. 3, no. 5, Sept. 1960, p. 441-452.

* **Spin Decoupling in High Resolution Proton Magnetic Resonance.** A simple unit is described which can be incorporated in a high resolution nuclear magnetic resonance spectrometer to remove the spin coupling between two groups of hydrogen nuclei in the same molecule. Applied to the molecule of propionaldehyde, the method considerably simplifies the analysis of the high resolution spectrum measured at 60 Mc/s. ***R. Freeman.*** *Molecular Physics*, v. 3, no. 5, Sept. 1960, p. 435-439.

* **Some Investigations in the Theory of Open-Shell Ions. III. The Calculation of Matrix Elements. IV. The Basis of Intensity Theory.** General formulae for all two-electron spin-orbit coupling matrices in an octahedral strong-field coupling scheme are deduced. The parametrization of the electrostatic energy in ligand field theory is discussed and the number of parameters required is given in various cases. The basis of the theory of electric dipole intensities in centrosymmetric ions is critically examined. It is shown that the physical assumptions of one current version [3, 4, 5] of this theory are mathematically inconsistent and the necessary revision of the theory is given. ***J. S. Griffith.*** *Molecular Physics*, v. 3, no. 5, Sept. 1960, p. 457-483.

* **The Use of Complex Wiggle-Beat Patterns for the Estimation of Small Splittings in NMR Spectra.** The simple example of mono-silane-d_1 (SiH_3D) is illustrated: $J_{HD} = 0.427 \pm 0.003$ c/s. Allowance is also made for the finite time of passage through the signal and the usefulness of this demonstrated by analyzing the beat pattern from the asymmetric spectrum of a mixture of SiH_3D and SiH_4. In this way the SiH_4-SiH_3D chemical shift is estimated to be 0.0080 ± 0.0005 p.p.m., the SiH_4 resonance being to low field. ***J. J. Turner.*** *Molecular Physics*, v. 3, no. 5, Sept. 1960, p. 417-424.

* **Magnetic Polarizability of a Short Right Circular Conducting Cylinder.** The magnetic polarizability tensor of a short right circular conducting cylinder is calculated in the principal axes system with a uniform quasistatic but nonpenetrating applied field. One of the two distinct tensor components is derived from results already obtained in connection with the electric polarizability of short conducting cylinders. The other is calculated to an accuracy of four to five significant figures for

cylinders with radius to half-length ratios of ¼, ½ 1, 2, and 4. ***T. T. Taylor.*** *U. S. National Bureau of Standards, Journal of Research, Section B, Mathematics and Mathematical Physics*, v. 64B, no. 4, Oct.-Dec. 1960, p. 199-210.

a

* **Experiments on the Passage of a Shock Wave Through a Magnetic Field.** General design considerations, apparatus, photographic observations, electromagnetic measurements are discussed. ***K. Dolder and R. Hide.*** *Reviews of Modern Physics*, v. 32, no. 4, Oct. 1960, p. 770-779.

b

* **The Kinetics of the Concentration Depolarization of Luminescence and of the Intermolecular Transfer of Excitation Energy.** According to the migration of the concentration depolarization of the fluorescence of solutions, in the concentration depolarization region, the decay time for that component of the radiation which is parallel to the electric vector of exciting light ($\tau_{\parallel}$) is shorter, and the decay time of the perpendicular component ($\tau_{\perp}$) larger, than the average fluorescence time (τ_0). The dependence of $\tau_{\perp} - \tau_{\parallel} / \tau_0$ on the concentration of the fluorescing material and the maximum value of this ratio are determined by the kinetics of the energy transfer. ***P. I. Kudryashov, B. Ya. Sveshnikov, and V. I. Shirokov.*** *Optics and Spectroscopy* (Cover-to-cover translation of *Optika i Spektroskopiia*), v. 9, no. 3, Sept. 1960, p. 177-181.

c

d

* **Motion of a Completely Ionized Gas Across a Magnetic Field in the Presence of an Electric Force.** Equations of motion, first approximation, first steps in the construction of a solution, simplifications in the equations of motion, equations obtained for the ions, search for a second uniform state of flow, results for the positive ions, for the electrons and other problems are discussed. ***J. M. Burgers.*** *Reviews of Modern Physics*, v. 32, no. 4, Oct. 1960, p. 868-880.

e

* **Problems in Magneto-Fluid Dynamics.** Basic processes, velocity zero, velocity infinitesimal, velocity finite but steady, velocity finite and nonsteady, observed magneto-fluids are discussed. ***Lyman Spitzer, Jr.*** *Reviews of Modern Physics*, v. 32, no. 4, Oct. 1960, p. 696-700.

f

* **Dynamical Equations and Transport Relationships for a Thermal Plasma.** Closure of the equations of change, collision integrals, Maxwells equations, continuity equations, momentum equations, energy equations, stress equations, heat-flux equations, transport relationships: general, first approximations, higher approximations, and distribution function are discussed. ***R. Herdan and B. S. Liley.*** *Reviews of Modern Physics*, v. 32, no. 4, Oct. 1960, p. 731-741.

g

* **Many-Body Perturbation Methods in a Soluble Model.** It is pointed out that because statistics should not be obeyed in Goldstone's perturbation expansion, there exist two-body contributions from diagrams other than ladders. The role of diagrams with "wrong" statistics is investigated in a model in which the perturbation is a single-particle potential. A summation of all diagrams is carried out in this model and compared to the sum of all ladders. It is found that the "wrong statistics" contributions are important in deciding the region of convergence of the series and the location and nature of the singularities which limit it. While the region of convergence of the series of ladders is limited by a pole on the real axis, the radius of convergence of the complete series (which is smaller) is marked off by two branching points off the real axis. ***Amnon Katz.*** *Nuclear Physics*, v. 20, no. 4, Nov. 1960, p. 663-689.

h

i

* **Density of Liquid Nitrogen and Argon as a Function of Pressure and Temperature.** Experimental results on the density of liquid N and Ar as a function of temperature and pressure are given from 90 to 65 K for liquid N and from 90 to 86 K for liquid Ar, both up to 150 kg/cm². A quadratic function is found for the density of the gas as a function of pressure. From the experimental results are calculated some thermodynamic properties as γ, Poissons ratio, and W, the velocity of sound. ***A. Van Itterbeek and O. Verbeke.*** *Physica*, v. 26, Nov. 1960, p. 931-938.

j

* **Unusual Low-Temperature Magnetic Behaviour of Some Cubic Crystals.** Electron spin resonance results on hexammine nickel halides are reported, which exhibit a low-temperature transition similar to that observed in some antiferromagnetics. Static susceptibility data, also reported, do not evidence such a low-temperature transition. These results are rather striking

k

and they cannot easily be interpreted in terms of the current knowledge on antiferromagnetism. Some remarks and suggestions are given concerning their interpretation. ***M. B. Palma-Vittorelli, M. U. Palma, G. W. J. Drewes, and W. Koerts.*** *Physica*, v. 26, Nov. 1960, p. 922-930.

Thermodynamic Properties of Liquid ^{3}He-^{4}He Mixtures Derived From Specific Heat Measurements Between 0.4°K and 2°K Over the Complete Concentration Range. Heat capacities of ^{3}He-^{4}He mixtures over the complete concentration range were measured using a calorimeter than can be cooled down to 0.4 K by means of evaporation of ^{3}He. Special attention was given to the additional contribution to the specific heat due to the heat of mixing which is observed when stratification takes place below the phase separation temperature and to the discontinuity in the specific heat at the corresponding lambda temperature. The excess entropy has been calculated. ***R. De Bruyn Ouboter, K. W. Taconis, C. Le Pair and J. J. M. Beenakker.*** *Physica*, v. 26, Nov. 1960, p. 853-888.

Electron Energy Distributions in Plasmas. II. Hydrogen. The mechanism of striation structure in H discharges was studied in the pressure range 0.01 to 0.1 mm Hg and the current range 0.016 to 0.800 A. The basic relations governing the current flow, ionization rate and energy flux are established and verified. These relations and this mechanism is not specific to H. ***R. L. F. Boyd and N. D. Twiddy.*** *Royal Society, Proceedings*, v. 259, ser. A, Dec. 6, 1960, p. 145-158.

Measurements With a Spectral Radiometer. An *f*/2.5 spectral radiometer, consisting of telescope and monochromator mounted on a movable head, is described. By comparison with a blackbody standard and appropriate calibration, spectral radiances can be obtained in watts/cm^2-micron-steradian. Observation on many targets indicates a nearly identical radiance for all. Space scans at a given wavelength do give target distinguishability however, and a discusison of possible cause is given. ***N. Ginsburg, W. R. Fredrickson, and R. Paulson.*** *Optical Society of America, Journal*, v. 50, Dec. 1960, p. 1176-1186.

Information Capacity of Radiation Detectors. The information capacity of a radiation detector is denoted by C and is measured in bits per second. The root-mean-square radiation power incident on the detector is denoted by P and is measured in watts. It is shown that for most detectors, the information capacity I has a maximum value for a finite and determinable value of the power *P.* ***R. Clark Jones.*** *Optical Society of America, Journal*, v. 50, Dec. 1960, p. 1166-1170.

Direct Determination of Line Shapes of Rotational Spectra From Interferometric Measuremnts. It is shown that all the structure present in the interferogram of an "ideal" rotational spectrum consisting of many equally spaced, identical lines is contained in a sequence of "signatures" at path differences of 0, $1/(2B)$, $2/(2B)$, where B is the reciprocal of inertia. For a symmetric line shape the signatures are all symmetric and homologous, the central one being upright and all successive ones inverted; but asymmetry in the line shape introduces increasing asymmetry in the successive signatures. ***Trevor Williams.*** *Optical Society of America, Journal*, v. 50, Dec. 1960, p. 1159-1162.

Attainment of High Resolution With Diffraction Gratings and Echelles. Reduction in the resolution given by actual gratings at angles above a certain maximum for a given wavelength usually arises from close-lying line-satellites originating from ruling defects. The use of gratings and echelles in series for increasing spectroscopic efficiency is discussed, and spectrograms made with two echelles thus used are shown. Two echelles used in series give high speed and resolution without the careful relative adjustment. ***George R. Harrison and George W. Stroke.*** *Optical Society of America, Journal*, v. 50, Dec. 1960, p. 1153-1158.

The Hyperfine Structure of the Hydrogen Molecular Ion. A calculation is presented of the energy levels of the hydrogen molecular ion in the ground state for different orientations of the electron spin, taking into account the coupling of the electron spin to the nuclear spin and to the nuclear rotational angular momentum. The first-order coupling terms are evaluated to very high accuracy, and quantitative results are given for the level splitting for a number of rotational levels. ***A. Dalgarno, T. N. L. Patterson, and W. B. Somerville.*** *Royal Society, Proceedings*, v. 259, ser. A, Nov. 22, 1960, p. 100-109.

a **Note on Gauge Transformations in Quantum Mechanics.** Gage transformations are treated from the point of view of unitary transformations in ordinary quantum mechanics. Gage-independent form of the constants of the motion is discussed. It is shown that the orbital angular momentum in an arbitrary gage is given by $rX[(p-eA) + \frac{1}{2}e(BXr)]$. ***A. O. Barut and M. Leiser.*** *American Journal of Physics*, v. 29, no. 1, Jan. 1961, p. 24-26.

PLASTICS

c * **Cellular Plastics.** Review designed to outline the different methods of production of cellular plastics, to describe their physical and chemical properties, and to show how the designer should set about choosing specific foams for particular purposes. ***L. N. Phillips.*** *Engineering Materials and Design*, v. 4, Jan. 1961, p. 12-17.

d **Cationic Copolymerization of Some α-Methylstyrenes With Vinyl 2-Chloroethyl Ether. Solvent Effects.** Reactivity ratios for vinyl 2-chloroethyl ether with α-methylstyrene, α, *p*-dimethylstyrene and *p*-methoxy-α-methylstyrene in a cationic system in the solvents benzene and nitrobenzene were determined. ***C. S. Marvel and James F. Dunphy.*** *Journal of Organic Chemistry*, v. 25, Dec. 1960, p. 2209-2211.

e * **Polymerization of Styrene in the Presence of Benzoyl Peroxide and Di-n-alkylaniline. XLIX. Vinyl Polymerization.** Polymerization of styrene was carried out in benzene at 30 C. Initial rate of polymerization was proportional to the square root of the initial concentrations of both benzoyl peroxide and di-n-alkylaniline. ***Kiichi Takemoto, Akira Nishio, Yuichi Iikubo, and Minoru Imoto.*** *Makromolekulare Chemie*, v. 42, no. 2, Dec. 1960, p. 97-107.

f * **Radical Polymerization of Acrylonitrile in Liquid Sulfur Dioxide.** Acrylonitrile was polymerized at 50 C, using azo-bis-isobutyronitrile as initiator. Product was homopolymer acrylonitrile irrespective of the conditions and the conversion. ***Niichiro Tokura, Minoru Matsuda, and Fumitake Yazaki.*** *Makromolekulare Chemie*, v. 42, no. 2, Dec. 1960, p. 108-120.

g * **The Stereospecific Polymerization of Butyl Acrylates With Strontium-Zinc Tetraethyl Complex.** Poly-isobutyl, sec-butyl and tert-butyl acrylate were synthesized through anionic polymerization with a strontium-zinc tetraethyl complex catalyst at low temperatures (−70 C to −78 C) in toluene. ***Junji Furukawa, Teiji Tsuruta, and Tsutomu Makimoto.*** *Makromolekulare Chemie*, v. 42, no. 2, Dec. 1960, p. 165-170.

h **Urethanes Beat Other Resins for Structural Laminates.** Shows that polyurethane resins used in laminates are fulfilling their early promise with better structural properties than other, commercially available resins. ***Angelo P. Bonanni.*** *Space/Aeronautics*, v. 35, no. 1, Jan. 1961, p. 95 + 3 pages.

i * **New Foam Materials Based on Polyvinyl Formal.** During partial saponification, polyvinyl alcohols containing ester groups are produced which are further saponified during acetalization, so that—in addition to acetal groups—there will be free alcohol and ester groups present in the macromolecule. Foams based on this polyvinyl formal have sponge like characteristics which are superior to natural sponge. Development, properties and uses of polyvinyl formal foams are discussed. (*In German.*) Neuartige Schwammprodukte auf Polyvinylformal-Basis. ***Robert Braun.*** *Kunststoffe*, v. 50, Dec. 1960, p. 729-732.

j * **Polymerization of Tetrahydrofuran.** Induction of polymerization is possible in all cases by the formation of an oxonium ion, with addition of a cation (H^+, R^+, Ac^+) to the oxygen atom of the tetrahydrofuran and with simultaneous introduction or with formation of a sufficiently stable complex anion. Chain growth always proceeds in the same manner and leads to an equilibrium between polyether oxonium salts and tetrahydrofuran. (*In German.*) Die Polymerisation des Tetrahydrofurans. ***H. Meerwein, D. Delfs, and H. Morschel.*** *Angewandte Chemie*, v. 72, no. 24, Dec. 21, 1960, p. 927-934.

• **Plastic Coated Steel Wire.** Reviews of the problems and processes involved in the manufacture of plastic-coated steel wire. ***Dartrey Lewis.*** *Wire and Wire Products,* v. 36, Jan. 1961, p. 41 + 6 pages.

• **High Density Polythene Monofilament.** Manufacture, properties and applications. ***E. Overgage and G. John.*** *British Plastics,* v. 34, Jan. 1961, p. 10-14.

• **The Free Expansion of P.V.C. Using Azodicarbonamide.** Survey describing the expansion of plasticized p.v.c. using azodicarbonamide as blowing agent and either very low or no external pressure. Emphasis is on plastisol formulation. Aspects considered include spreading on to a metal plate, treated paper, p.v.c. sheet or fabric; calendering and extrusion of pre-gelled compounds; and low pressure molding. ***D. J. Cram, C. M. Lavender, R. A. Reed, and A. Schofield.*** *British Plastics,* v. 34, Jan. 1961, p. 24-29.

• **Radiation Chemistry and Polymer Technology. I.** Survey of the patent literature on the subject of radiation chemistry with special reference to polymer technology. ***S. H. Pinner.*** *British Plastics,* v. 34, Jan. 1961, p. 30-33.

• **Use and Results of X-Ray Low Angle Dispersion in Solid High Polymers.** The theory and method was studied in amorphous systems evaluated according to size, shape and polydispersion, and in crystalline, oriented, inoriented and ordered systems. In oriented systems the meridian reflexes were explained and the equatorial low angle dispersion was examined, especially in the case of cellulose exhibiting a diffuse background which might be interpreted as the effect of microcavities. (*In German.*) Anwendung und Ergebnisse der Röntgenkleinwinkelstreuung in festen Hochpolymeren. ***G. Porod.*** *Fortschritte der Hochpolymeren-Forschung,* v. 2, no. 3, 1961, p. 383-400.

• **Mechanism of Acrylonitrile Polymerization.** Review deals with current ideas on the mechanisms operative in acrylonitrile polymerization. ***W. M. Thomas.*** *Fortschritte der Hochpolymeren-Forschung,* v. 2, no. 3, 1961, p. 401-441.

• **Recent Progress in Silicone Chemistry. I. Hydrolysis of Reactive Silane Intermediates.** ***M. M. Sprung.*** *Fortschritte der Hochpolymeren-Forschung,* v. 2, no. 3, 1961, p. 442-464.

• **The Electrochemistry of Vinyl Polymer Membranes.** Investigation of vinyl polymers indicate that these resins act unexpectedly as permselective membranes of very low ion exchange capacity. Their permselectivity can be of practical importance in helping to explain how metal ions could diffuse across otherwise mechanically perfect films used as protective barriers. ***Charles A. Kumins and Arnold London.*** *Journal of Polymer Science,* v. 46, Oct. 1960, p. 395-408.

• **Crystalline Acrylic Polymers. I. Stereospecific Anionic Polymerization of Methyl Methacrylate.** Isotactic polymers were obtained from anionic polymerizations initiated by organolithium compounds at low temperature (−70°) in toluene solution. ***W. E. Goode, F. H. Owens, R. P. Fellmann, W. H. Snyder, and J. E. Moore.*** *Journal of Polymer Science,* v. 46, Oct. 1960, p. 317-331.

• **Polyethers. X. Endgroups in Polyethylene Oxide.** High concentrations (10% or greater) of zinc chloride or mixtures of aluminum isopropoxide–zinc chloride catalyzed the polymerization of ethylene oxide to low molecular weight polymer. Endgroup analysis of the polymer gave a 1:1 ratio of hydroxyl to chloride when zinc chloride was the catalyst. ***Philip E. Ebert and Charles C. Price.*** *Journal of Polymer Science,* v. 46, Oct. 1960, p. 455-474.

• **On the Mechanism of Polymerization Retardation by Hydroquinone.** Mechanism of the reaction between hydroquinone and polymethyl methacrylate free radicals by an accurate kinetic method. ***Robert G. Caldwell and Judson L. Ihrig.*** *Journal of Polymer Science,* v. 46, Oct. 1960, p. 507-516.

POLLUTION AND WASTES

• **Status of Preparation of Sulfuric Pickling Plant Sewage.** Physical and chemical methods including neutralization, production of heptahydrate, and monohydrate. (*In German.*) Stand der Aufbereitung von schwefelsauren Beizereiabwässern. ***Kurt Mathesius.*** *Neue Hütte,* v. 5, Nov. 1960, p. 641-646.

• **The Prevention of Air Pollution by Diesel Vehicles.** ***G. J. Waring.*** *Gas and Oil Power,* v. 56, no. 673, Jan. 1961, p. 17-18.

• **The Luton Experiment.** Describes a detergent which can be more readily decomposed during sewage treatment. ***B. A. Southgate and G. E. Eden.*** *Chemical & Process Engineering,* v. 42, Jan. 1961, p. 5 + 4 pages.

Disposition of Nuclear Fallout Debris. Annual report. ***Arthur R. Schulert, et al.*** *U. S. Atomic Energy Commission, NYO-9466,* Oct. 1, 1960, 178 pp. (UF767 U3ny Contin.)

• **Sewage Sludge Conditioning With Sulphur Oxidizing Bacteria.** A reduction in pH of digested sewage sludge considerably improves its filtration characteristics. Under aerobic conditions with a supply of elemental sulfur the pH can be reduced by microbial sulfuric acid synthesis. A semi-continuous process of sludge conditioning by this method was evolved, which would continue if the pH did not rise above pH 7 and if sufficient sulfur was supplied. ***Wendye E. Johnston and K. J. Ives.*** *Journal of Biochemical and Microbiological Technology and Engineering,* v. 2, no. 4, Dec. 1960, p. 401-410.

• **Possibility of Using Filamentous Algae for the Purification of Water Reservoirs Polluted With Radioactive Substances.** The algae tested possess a natural specificity relative to isotopes, thus *Spirogyra* gives a coefficient of accumulation of 475 for Sr^{90}, of 23,700 for Ce^{144}, claphora gives 855 for Sr^{90} and 1571 for Ce^{144}. Mineral salts have no effects on the accumulation of radioisotopes by algae, but stimulate the growth of the algae, increasing their biomass by 38.2% as compared with the control. (*In Russian.*) O vozmozhnosti ispol'zovaniia nitchatykh vodorosleĭ dlia ochistki radioaktivno zagriaznennykh vod. ***G. M. Kulikova.*** *Akademiia Nauk SSSR, Doklady,* v. 135, no. 4, Dec. 1960, p. 978-980.

RELIABILITY ENGINEERING

• **Engineering of Microwave Systems—Appendix.** A section on reliability. ***William H. Francis.*** *Western Union Technical Review,* v. 15, no. 1, Jan. 1961, p. 2-16.

Getting Reliable Components for Minuteman Guidance. In-the-hole reliability for periods of several years is the objective. ***Bernard Kovit.*** *Space/Aeronautics,* v. 35, no. 1, Jan. 1961, p. 143 + 8 pages.

Ultra-Reliability Can Be Built Into Electronic Circuits. An air-borne S-band telemetry receiver with a 0.1-cu ft unit with a predicted life of 36,500 hours. ***Daniel P. Sante.*** *Space/Aeronautics,* v. 35, no. 1, Jan. 1961, p. 134-140.

Mortality Curves Spot Reliability Problems. Auto industry takes a cue from insurance companies—it uses mortality curves to pinpoint failure rates of complex apparatus. Case histories show how reliability can be improved. ***A. J. Hofweber.*** *SAE Journal,* v. 69, Feb. 1961, p. 41-43.

• **Factor of Safety Based on Probability.** Functional failure of a component depends on the relationship between applied load and component strength, both of which are subject to random variations. The cause and nature of the variations are discussed and their effect on the probability of failure considered. ***N. L. Svensson.*** *Engineering,* v. 191, Jan. 27, 1961, p. 154-155.

RUBBER AND ELASTOMERS

• **Attrited Carbon Blacks and Their Behavior in Elastomers. III. Effect of Attrited Blacks on SBR and Other Rubbers.** Cure of SBR is severely retarded in compounds with attrited blacks. This retardation is not found in butyl, natural, and acrylonitrile-butadiene polymers containing the same blacks, but is associated with the sensitivity of SBR to acidity on the part

of the black. The cure of SBR-attrited black compounds is sharply activated when glycerol or other aliphatic polyols are added in the compound. A combined reinforcement-vulcanization reaction is therefore envisioned to include the polymer, the black, sulfur, and glycerol as the reactants. ***A. M. Gessler.*** *Rubber Age*, v. 88, no. 4, Jan. 1961, p. 658-672.

* **Compounding Oil Resistant Silicone Rubber.** A general purpose compound was formulated to have good oil resistance. The object of this work was to provide silicone rubber fabricators with techniques for obtaining maximum oil resistance using general purpose silicone rubber reinforced gums. ***Robert L. Daileader.*** *Rubber Age*, v. 88, no. 4, Jan. 1961, p. 643-649.

* **The Principle of Synthesis of the Urethan Elastomers "Vulkollan".** A review is given about the synthesis of elastomers from diisocyanates and long chain nonpolar glycols which has led to commercially valuable products, the so-called Vulkollans. From this group a new material, Hard Vulkollan, has been developed, a hard material of high strength showing great elasticity under the influence of impacts and quick vibration. (*In German.*) Das Aufbauprinzip der Urethan Elastomeren "Vulkollan". ***Otto Bayer and Erwin Müller.*** *Angewandte Chemie*, v. 72, no. 24, Dec. 21, 1960, p. 934-939.

* **Synthetic Rubbers and Fibres.** An evaluation of the papers presented at the International Rubber Conference in Berlin on Oct. 4-8, 1960. ***William C. Wake.*** *Rubber Age*, v. 88, no. 4, Jan. 1961, p. 676-683.

* **Effect of the Chemical Nature of Carbon Black Surface on Its Interaction With Rubber and Sulfur and on the Vulcanization Kineties.** It has been shown that the quantity of rubber sorbed from n-heptane solution and of bound rubber in stocks prepared by mastication and heated at the vulcanization temperature, calculated per unit surface area of the black, is greater the less the number of oxygen-containing groups on the surface of the latter. Sulfur chemisorbed on the surface of the black participates in the formation of additional cross links of the vulcanization structure. Oxidation of the blacks leads to a fall in pH, owing to which the rate of vulcanization is retarded and the limiting amount of chemically bound sulfur and the module diminish in value. (*In Russian.*) O vliianii khmicheskoĭ prirody poverkhnosti sazhi na vzaimodeĭstvie s kauchukom i seroĭ i na kinetiku vulkanizatsii. ***B. A. Dogadkin, Z. V. Skorodumova, and M. S. Fel'dshteĭn.*** *Kolloidnyĭ Zhurnal*, v. 22, no. 6, Nov.-Dec. 1960, p. 663-670.

* **Studies on the Nature of the Bond in the System Rubber-Filler.** The distribution of aluminum hydroxide as filler in the butadiene-nitrile rubber SKN-26 has been investigated. Aluminum hydroxide was prepared both during the process of coagulation of the latex and separately with subsequent incorporation into the rubber on the rolls. A difference has been found between the distributions of the filler prepared by the two methods. Suggestions have been made as to the nature of the bond between the rubber and the filler in the systems. (*In Russian.*) K voprosu izucheniia kharaktera sviazi v sisteme kauchuk-napolnitel'. ***V. A. Shvetsov, A. P. Pisarenko, and A. S. Novikov.*** *Kolloidnyĭ Zhurnal*, v. 22, no. 6, Nov.-Dec. 1960, p. 743-747.

* **The Causes of Gelation in Rubber Latexes.** The transformation of a rubber latex to a gel takes place in the formation of the latex or diffusion into it of ions stabilizing the globules. In the process a coagulum layer grows about the coagulation centers. Gelation ends when the layers join each other with the formation of a coagulum network. (*In Russian.*) Prichiny geleobrazovaniia v kauchukovykh lateksakh. ***D. M. Sandomirskiĭ and I. D. Pil'menshteĭn.*** *Kolloidnyĭ Zhurnal*, v. 22, no. 6, Nov.-Dec. 1960, p. 761-762.

* **Bulk Polymerization of Isoprene: Kinetic Constants From the Dead-End Theory.** Dead-end radical polymerization theory of Tobolsky was applied to the bulk polymerization of isoprene. 2-Azobisisobutyronitrile and benzoyl peroxide were used as initiators in the temperature range 60-90 C. Isoprene shows a dead-end conversion under all the conditions used. ***R. H. Gobran, M. B. Berenbaum, and A. V. Tobolsky.*** *Journal of Polymer Science*, v. 46, Oct. 1960, p. 431-440.

* **The Reaction of Phosphorus Pentachloride With SBR Rubber.** ***J. P. Schroeder.*** *Journal of Polymer Science*, v. 46, Oct. 1960, p. 547-550.

SPACE HEATING AND CONDITIONING

The Temperatures Under Houses Erected Immediately on the Ground and the Heat Losses From Their Foundation Slab. Contains a theoretical treatment of the thermal conditions in the soil under a heated floor slab and of the heat losses from the slab into ground. The results from measurements carried out in experimental houses, relating to temperature and moisture conditions in the soil and to the heat losses from the slab into ground in the different seasons, are presented. ***Olavi Vuorelainen.*** *Acta Polytechnica Scandinavica, Civil Engineering and Building Construction Series No.* 9, 1960, 105 pp. (TI Ac81ci Vis.)

How to "Build" Electronic Control Systems. Once the fundamental principles and operations of electron controls are understood, and their application to various heating and cooling requirements appreciated, the engineer can proceed to "build" the control system he needs by combining electronic and electric components to suit specific uses. ***John Schwartz.*** *Heating, Piping & Air Conditioning*, v. 33, Feb. 1961, p. 122-127.

How Finned Streamlined Heat Exchanger Tubes Perform. The chief applications of the finned streamlined heat exchanger tube would be in the refrigeration, heating, and air conditioning fields. Additional study is needed to completely evaluate the utility of finned streamlined tubes. ***David M. Adams.*** *Heating, Piping & Air Conditioning*, v. 33, Feb. 1961, p. 131-138.

* **Process Air Handling at Ford Transmission Plant.** Details of air handling for tool grinding, automatic brushing, welding, heat treat blast, machine transfer and anodizing are given. ***Eugene Carsey and Lowell Shimp.*** *Air Engineering*, v. 3, no. 2, Feb. 1961, p. 26-30.

* **How to Cut Costs by Integrating Building and Systems Design.** Specific suggestions are given on integrating building design with the mechanical system design and equipment. ***Gershon Meckler.*** *Air Engineering*, v. 3, no. 2, Feb. 1961, p. 31 + 3 pages.

* **New Ideas in Ventilation.** Describes ventilation of free silica in the buffing and polishing industry, control of radioactive materials in chemical laboratories, dust control in mines, quarries and construction. ***James Barrett.*** *Air Engineering*, v. 3, no. 2, Feb. 1961, p. 39 + 3 pages.

* **The Economics of Factory Air Conditioning.** Shows how air conditioning, just like any other capital investment, will give you more than a net return on your money. ***Eugene A. Sloane.*** *Air Engineering*, v. 3, no. 2, Feb. 1961, p. 20 + 7 pages.

Influence of Unshaded Window Area on Selection of Peripheral Air Conditioning. The ratio of solar radiation entering through windows to total sensible cooling demand governs the relative economy and convenience (and hence the logical choice) of the several air conditioning systems that may be utilized. Gives details and costs of five different systems. ***Alfred L. Jaros, Jr.*** *ASHRAE Journal*, v. 3, Jan. 1961, p. 66-69.

Urban Central Heating Plant Controls Smoke, Dust, Noise Automatically. The new coal-fired heating plant which serves the various buildings of Northwestern University's downtown campus is located within an elite Chicago residential district yet the surrounding neighborhood is unoffended by sight, smell or touch. *Heating, Piping & Air Conditioning*, v. 33, Feb. 1961, p. 113-116.

TEXTILES, FIBERS, LEATHER, AND PAPER

* **Studies on Pulp Crill. III. Influence of Crill on Some Properties of Pulp and Paper.** The Schopper Riegler wetness, the sheet formation time and the permeability of paper to air are highly influenced by the amount of crill present. The influence of crill on tensile strength and stretch is small. ***Berit Sandgren and Douglas Wahren.*** *Svensk Papperstidning*, v. 63, no. 24, Dec. 31, 1960, p. 879-883.

* **Max-Planck Institute for Albumin and Leather Research [Münich, Germany].** This is one of a series of reports concerning the activities of the Max Planck Society during a recent two-year period. Investigations of normal collagens (650 Å period), and of long-spacing segments (2700 Å period) where 2600 to 2800 Å long molecules of tropocollagen lie parallel, were reported. The adsorption of polyamide columns has proved suitable for the separation of aromatic nitrocompounds and of quinones. Progress in the biogenesis of piceatannol was mentioned. (*In German.*) Max-Planck-Institut für Eiweiss- und Lederforschung. *Naturwissenschaften,* v. 47, no. 24, Dec. 1960, p. 567.

* **Static Electrification of Filaments: Effect of Filament Diameter.** Findings are consistent with the hypothesis that the charge transferred is proportional to the true area of contact (that is, the area over which interpenetration of molecular fields occurs) swept out on the object of lower conductivity. ***D. J. Montgomery, A. E. Smith, and E. H. Wintermute.*** *Textile Research Journal,* v. 31, Jan. 1961, p. 25-31.

* **The Relationship Between Cotton Fiber Development and Fiber Properties.** ***Lyle E. Hessler.*** *Textile Research Journal,* v. 31, Jan. 1961, p. 38-43.

* **New Methods for Sizing Fibrous Products.** ***G. D. Sinclair, R. S. Evans, and H. R. Sallans.*** *Pulp and Paper Magazine of Canada,* v. 62, Jan. 1961, p. T23-T27.

* **The Science of Chemical Additives in Papermaking.** A comprehensive review of the effects of, and mechanism of action of papermaking additives. ***John W. Swanson.*** *Tappi,* v. 44, Jan. 1961, p. 142A-181A.

* **The Science of Paper Manufacture.** Reviews the fundamental scientific principles related to paper technology. ***P. E. Wrist.*** *Tappi,* v. 44, Jan. 1961, p. 181A-199A.

* **The Measurement of Fibre Flexibility.** A relatively simple apparatus and method for the estimation of fiber flexibility are described. The method is based on the observation that fibers, suspended in a liquid and subjected to laminar shear, describe rotational orbits which reflect their individual flexibilities. Observation of the behavior of a representative sample of fibers under standard conditions permits the evaluation of a "flexibility index" for the pulp. Both wet and dry flexibility may be determined by this method. ***A. A. Robertson, E. Meindersma, and S. G. Mason.*** *Pulp and Paper Magazine of Canada,* v. 62, Jan. 1961, p. T3-T10.

* **Stabilization of Wool Fabric by Interfacial Polymerization.** ***R. E. Whitfield, L. A. Miller, and W. L. Wasley.*** *Textile Research Journal,* v. 31, Jan. 1961, p. 74.

* **Beating, Interfiber Bonding, and Sheet Strength.** Screen classification of pulp yields fractions that show rather constant physical properties after initial beating. These physical properties remain the same despite progressive beating and changing properties of the whole pulp. Pulps reach rather constant and characteristic physical properties after initial beating and removal of the fiber debris. ***Ferdinand Wultsch and Rudolf Schmut.*** *Tappi,* v. 44, Jan. 1961, p. 38-42.

* **Egyptian *Phragmites communis* L. as a Pulp Source.** Experimental cooks were made on *Phragmites communis* (L.) of the Edku Lake, Lower Egypt, by the soda, kraft, neutral sulfite processes, the pulps were analyzed chemically and tested for physical strength properties. The results indicated the suitability of using the reed as a pulp source. ***M. A. El-Taraboulsi.*** *Tappi,* v. 44, Jan. 1961, p. 4-7.

* **Science of Wood Pulping.** The structure and chemical composition of wood, conversion of wood to pulp, bleaching, chemical recovery, and by-product recovery are discussed. ***G. H. Tomlinson, II.*** *Tappi,* v. 44, Jan. 1961, p. 133A-142A.

WELDING AND JOINING

Axles Welded in a Vapor Shield. Mechanized auto line uses innershield welding. ***R. H. Eshelman.*** *Iron Age,* v. 187, no. 3, Jan. 19, 1961, p. 78-80.

Welding in the Production of Marine Oil Engines. Distortion, manipulation, and inspection are considered. ***J. A. Dorrat.*** *British Welding Journal,* v. 8, Jan. 1961, p. 10-17.

Effect of Vibrations of Ultrasonic Frequency on Crystallization Pattern of Weld Puddles. ***A. A. Erokhin, Yu. I. Kitaigorodskii, M. G. Kogan, and L. L. Silin.*** *Henry Brutcher Translation No.* 4905, 5 pp. (From *Izvest. Akad. Nauk SSSR, OTN,* 1958, no. 1, p. 140-142.) Henry Brutcher, Altadena, Calif.

MISCELLANEOUS

* **The Iterative Solutions of the Analytical *N*-Body Problem.** Confines its solution of the *N*-body problem to the analytic case, namely, to that motion expressible by functions regular in a region. This, of course, excludes, among other things, a collision theory. However, this limitation still allows the field of inquiry sufficient generality to include some of the most useful situations in the dynamics of *N*-bodies. ***L. M. Rauch and W. C. Riddell.*** *Society for Industrial and Applied Mathematics, Journal,* v. 8, no. 4, Dec. 1960, p. 568-581.

* **A Bibliography on Approximate Integration.** This bibliography is an attempt to provide a reference to the knowledge concerning approximate integration methods, and to make better known the recent contributions to this field. ***A. H. Stroud.*** *Mathematics of Computation,* v. 15, no. 73, Jan. 1961, p. 52-80.

* **Approximation of Curves by Line Segments.** Since the problem of obtaining a best fit of broken line segments to a curve does not seem to have been previously investigated, it is the purpose of this paper to formulate the problem, give a closed form solution when the given function is quadratic, show a general numerical method of solution, and apply this numerical procedure to the lead susceptibility curve. ***Henry Stone.*** *Mathematics of Computation,* v. 15, no. 73, Jan. 1961, p. 40-47.

* **Two Theorem Tables of Matrix Algebra.** Shows how it is possible, by a slight modification of the mode of presentation, to state many of the theorems of matrix algebra in table form. Due to the large number of theorems presented, the tables give only the statement of each theorem. It is not considered feasible to attempt to indicate sources and proofs. ***Gilbert C. Best.*** *Mathematics of Computation,* v. 15, no. 73, Jan. 1961, p. 19-22.

* **U.S. Passenger Agency Urged.** It seems desirable to investigate and ultimately to adopt a plan whereby "United States" intercity passenger services (suburban lines excluded) would be cooperatively provided by all participating railroads. ***Charles E. Stonier.*** *Railway Age,* v. 150, Jan. 23, 1961, p. 27-28.

* **The Cutting-Plane Method for Solving Convex Programs.** Proposes a method for solving convex programs which appears to be computationally efficient and works under rather general assumptions. The method is an outgrowth of a study of the Chebyshev curve fitting problem. ***J. E. Kelly, Jr.*** *Society for Industrial and Applied Mathematics, Journal,* v. 8, no. 4, Dec. 1960, p. 703-712.

* **Chebyshev Approximation by $ab^x + c$.** The theory of Chebyshev approximation by $ab^x + c$ is studied, where a, b > 0, and c are parameters to be determined. A complete development of the theory is made. ***John R. Rice.*** *Society for Industrial and Applied Mathematics, Journal,* v. 8, no. 4, Dec. 1960, p. 691-702.

Britain to Revamp Technical Education. Minister of education proposes major reconstruction to increase numbers of new technicians, craftsmen, and operatives. *Chemical & Engineering News,* v. 39, no. 4, Jan. 23, 1961, p. 44-45.

Maintaining Life on Space Missions. This involves supplying necessities, disposing of waste, letting crew know true conditions through visual displays. ***R. B. Wilson.*** *SAE Journal,* v. 69, Jan. 1961, p. 55-57.

* **A Study of Visual Prediction Behavior.** Concerns using a visual tracking task with 16 experienced radar scope operators. ***Robert H. Davis and Richard A. Behan.*** *Human Factors,* v. 2, no. 4, Jan. 1961, p. 228-234.

* **A Two-Point Method for the Numerical Solution of Systems of Simultaneous Equations.** Concerns the problem, which arises frequently in practice, of finding one or more solutions of a set of n simultaneous equations $\psi_i(x_1, \ldots, x_n) = 0, i = 1, \ldots, n$, in n unknowns $x_1, \ldots, x_n$. For convenience we shall assume, as is usually true in actual cases, that the functions ψ_i are analytic in a region surrounding each solution of interest, although the approach used would remain applicable under much milder conditions. ***W. M. Kincaid.*** *Quarterly of Applied Mathematics,* v. 18, no. 4, Jan. 1961, p. 313-324.

* **Engineers' Incomes—Going Up?** The 1960 report by the Engineers' Guild. *Engineering,* v. 190, Dec. 30, 1960, p. 18.

Boundary Problems in Differential Equations. Proceedings of a symposium conducted by the Mathematics Research Center at the University of Wisconsin, Madison, Apr. 20-22, 1959. ***Rudolph E. Langer, editor.*** 2nd Ed. 324 pp. 1960. The University of Wisconsin Press, Madison, Wis. (QA371 L26b)

The Moral Un-Neutrality of Science. Deals with one of the most interesting and difficult aspects of the interrelatedness of science with all the rest of life, an interrelationship which many disregard, which most debate, and which some deny—the moral un-neutrality of science. ***Charles P. Snow.*** *Science,* v. 133, Jan. 27, 1961, p. 255-262.

* **On Uniqueness in Cauchy Problems for Elliptic Systems of Equations.** Regular, complex characteristics with multiplicities, at most two are the subject of this paper. It is shown that the solutions of systems of linear equations with such characteristics are uniquely determined by their Cauchy data. ***Avron Douglis.*** *Communications on Pure and Applied Mathematics,* v. 13, no. 4, Nov. 1960, p. 593-607.

* **Continuous Dependence on Data for Solutions of Partial Differential Equations With a Prescribed Bound.** ***Fritz John.*** *Communications on Pure and Applied Mathematics,* v. 13, no. 4, Nov. 1960, p. 551-585.

* **Some Non-Selfadjoint Operators.** Exhibits a case in which a limit exists for a wide class of intervals e, but in which the operators $E(e)$ are not uniformly bounded, showing instead a simple sort of singularity which, though impossible for self-adjoint operators, is in all probability rather typical for non-selfadjoint operators. ***Jack Schwartz.*** *Communications on Pure and Applied Mathematics,* v. 13, no. 4, Nov. 1960, p. 609-639.

* **Infinitesimally Homogeneous Spaces.** Answers the question, how alike must two points of a Reimannian manifold be in order to conclude that the manifold is homogeneous, i.e., that there is a transitive group of isometries of the manifold? ***I. M. Singer.*** *Communications on Pure and Applied Mathematics,* v. 13, no. 4, Nov. 1960, p. 685-697.

Expenditures on Recreational Boating at All-Time High in 1960. ***Charles A. Weinert.*** *Automotive Industries,* v. 124, no. 2, Jan. 15, 1961, p. 63-65.

* **On *kTH* Best Policies.** In a number of situations where only a finite number of possible decisions are possible, there is no question as to the existence of an optimal policy. However, if the number of possibilities is large, then no straightforward enumeration of cases is feasible, and one is forced to develop more elegant, if less simple, techniques. In the course of doing this, the question arises as to whether or not it is possible to determine the preferred suboptimal policies. This has significance in connection with sensitivity analysis. ***Richard Bellman and Robert Kalaba.*** *Society for Industrial and Applied Mathematics, Journal,* v. 8, no. 4, Dec. 1960, p. 582-588.

* **Controlling Health Hazards in Chemical Works.** Safety demands unceasing vigilance. This article restates some of the first principles of industrial safety and emphasizes the importance of supervision and attention to detail. ***V. A. Broadhurst.*** *Manufacturing Chemist,* v. 32, Jan. 1961, p. 28-30.

* **Automobile Collisions on Purpose.** Presents a brief discussion of some of the findings from 48 full-scale automobile collision experiments conducted at UCLA during the past 10 years. ***Derwyn M. Severy.*** *Human Factors,* v. 2, no. 4, Jan. 1961, p. 186-202.

* **Similarity Classifications of Complex Matrices.** Concerns matrices under similarity transformations. ***John S. Lomont, John E. Maxfield, and R. G. Selfridge.*** *Mathematics Magazine,* v. 34, no. 3, Jan.-Feb. 1961, p. 147-152.

a * **How Much Longer Can London Survive?** Traffic congestion can be overcome by keeping the cities largely as they are and excluding private cars; or by rebuilding them. Either choice means the end of cities as they are today. ***R. G. Pay.*** *Engineering,* v. 190, Dec. 23, 1960, p. 850-851.

b **Vector Analysis With Applications to Geometry and Physics.** Vector algebra, statics, differentiation of vectors, kinematics, vector integral calculus, dynamics, general coordinates, differential geometry, harmonic functions, electrostatics, magnetism and electrodynamics, and linear vector functions are discussed. ***Manuel Schwartz, Simon Green, and W. A. Rutledge.*** 556 pp. 1960. Harper & Brothers, New York. (QA261 Sch95r)

c * **Number—The Language of Engineering.** A comprehensive explanation of the growth and meaning of the so-called elementary branches of mathematics. ***Norman P. Salz.*** *Electro-Technology,* v. 66, no. 4, Oct. 1960, p. 128-142.

d * **Colour Confusion Produced by Voluntary Fixation.** When an observer stares at a color-matching field, he may lose a great deal of his color discrimination. Some find it possible to match any pair of spectral colors. Prolonged staring is not necessary, but the colors must be exactly matched in brightness. A systematic study of the fixation effects indicates that they are not due to a photochemical bleaching of pigments, but rather to the reduction of eye movements. Blue-green discrimination is affected more than yellow-red. ***K. J. McCree.*** *Optica Acta,* v. 7, no. 3, July 1960, p. 281-290.

e * **Predicting Performance Evaluations.** The purpose of this study was, first to develop a performance evaluation procedure for use with clerical employees, and, second, to validate a series of selection measures—the interview and objective personality and performance tests. ***Joel T. Campbell, Erich P. Prien, and Lester G. Brailey.*** *Personnel Psychology,* v. 13, no. 4, Winter 1960, p. 435-440.

f **A Structure of Science.** Discusses science and its devotees, the concept of science and a tidy universe. ***Joseph H. Simons.*** 269 pp. 1960. Philosophical Library, New York. (Q175 Si57s)

g **Strategy in the Missile Age.** Reviews development of modern military strategy to World War II, and presents an analysis of the requirements of strength for the 1960's including especially the military posture necessary to prevent war; unique feature is discussion of problem of cost of preparedness in relation to the requirements of the national economy. ***Bernard Brodie.*** 423 pp. 1959. Princeton University Press, Princeton, N. J. (UG630 B78s)

h **Sociological Aspects of Economic Growth.** Describes the scope and history of theories of economic growth, social structure and economic growth, a sociological approach to economic development, patterns of economic growth, population pressure, industrialization and social mobility, entrepreneurship, and other problems. ***Bert F. Hoselitz.*** 250 pp. 1960. The Free Press of Glencoe, Glencoe, Ill. (HD82 H79s)

i **Readings in Russian Foreign Policy.** Purpose is to serve as source material for discussion groups, and to offer the general reader an opportunity to acquaint himself systematically with the best thoughts on fundamental problems. ***Robert A. Goldwin, Gerald Stourzh, and Marvin Zetterbaum, editors.*** 775 pp. 1959. Oxford University Press, N. Y. (DK65 G58r)

j **Progress in Vacuum Science and Technology.** Some vacuum problems in the valve industry, the gettering process in modern receiving valve manufacture, vacuum metallurgy in the U. S., vacuum fumigation, vacuum drying, molecular distillation are discussed. ***A. S. D. Barrett, editor.*** 160 pp. 1959. Pergamon Press, New York. (QC166 B27p)

k **Regression Analysis.** Discusses linear regression, multiple and polynomial regression, regression equations requiring iterative calculation, choice among regression formulas, estimation from the regression equation, the analysis of covariance, the treatment of heterogeneous data, simultaneous regression equations, discriminant functions, and functional relations. ***E. J. Williams.*** 214 pp. 1959. John Wiley & Sons, New York. (QA276 W67r)